NORTH-HOLLAND

An Integrated Socioeconomic Analysis of Innovation Adoption: The Case of Hybrid Cocoa in Ghana

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This study employs a multidisciplinary model to explain the adoption of agricultural innovations in developing economies with reference to hybrid cocoa in Ghana. The empirical evidence shows that, in the adoption of hybrid cocoa, the support that small-scale farmers obtain via their social networks is more relevant than the advantage of farm size enjoyed by large-scale farmers. However, for large-scale farmers, access to a bank loan strongly increases their chance of adoption compared with small-scale farmers. Contacts with extension agents, education, and availability of hired labor also have positive effects on adoption. The social status of the farmers has only an indirect effect on adoption: farmers with higher social status are more likely to obtain a bank loan, and a bank loan has a positive impact on adoption.

1. INTRODUCTION

In the past, most of the increases in agricultural production have been achieved through the expansion of cultivated land and intensive use of labor, rather than the use of improved farming technologies. As fertile land becomes scarce due to increased population growth, the rise in environmental problems, and the

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Received March 1996; final draft accepted November 1996.

Journal of Policy Modeling 21(2):167–184 (1999)

Published by Elsevier Science Inc.

0161-8938/99/$–see front matter
PII S0161-8938(97)00070-7

economically active rural dwellers—an invaluable source of farm labor—migrate to the urban areas, the use of improved farm technologies, for example, hybrid seeds and new farm practices to boost output, has become essential. Nevertheless, where new crop varieties have been introduced, the expectation of increased output has been only partially fulfilled because the adoption has not been immediate across the farmers.

Scholars of adoption studies have, accordingly, sought to explain the differences in adoption behavior. Innovation adoption is subject to a combination of social, economic as well as cultural factors but most of the theoretical models have tended to present *discipline-guided* explanations. As Clark and Staunton (1989) observed, adoption studies have, to a large extent, been dominated by a division of analysis between economists, sociologists, and geographers. Adoption has been explained in terms of the profitability of the investment (economics),[1] the social rewards associated with adoption and the nature of communication channels (sociology),[2] spatial differences in resource endowment (geography) and the compatibility of the innovation with the norms of the society (anthropology).

The *discipline-guided* models are not contradictory, but represent different aspects of the adoption process. They reveal that innovation adoption is a multi-dimensional process incorporating elements such as (1) perceived relative profitability (or attractiveness), (2) costs of establishment (including the ability to bear the investment costs and risks associated with innovating), (3) compatibility with value systems, and (4) the ease of communication, i.e., the ability to convey the innovation to other potential adopters. This study seeks to integrate economic and sociological considerations to account for hybrid cocoa adoption in Ghana.

[1] Recent attempts by economists to include sociological considerations in the adoption process have mainly stressed the possibility of late adopters copying or imitating early adopters to illustrate the problem of free riding the investments in information made by early adopters (Bevan et al., 1989; Pomp and Burger, 1995).

[2] A strand of adoption research pursued mainly by sociologists, geographers, and economic anthropologists interested in rural development in the developing economies has, however, recognised that the adoption of an innovation has a strong economic dimension. Their analyses have been purely empirical by assessing the relative importance of economic and non-economic variables in a regression model (Hooks et al., 1983; Nowak, 1987), a discriminant model (Shaw, 1985) and exploratory path models (McIntosh and Zey-Ferrel, 1986) or as in economic anthropology, it has involved a detailed descriptive account of the individual's farming activity.

We examine both theoretically and empirically the role of profit and other economic variables as well as the farmers' social and institutional setting in the adoption process. The questions we have sought to answer in this study include the following: Is the economic situation of the farmers more important than their skills and the nature of their social networks in the adoption of hybrid cocoa? Given the availability of support from acquaintances, are there differences between the adoption behavior of large- and small-scale farmers? What effect does social status have on adoption behavior? We begin the study with a presentation of a model of adoption. Then we discuss the data obtained from a field survey carried out among cocoa farmers in Ghana, and subsequently present conclusions and policy implications.

2. THEORETICAL CONSIDERATIONS

In Ghana, some of the important agricultural innovations have occurred in cocoa production. These innovations include hybrid cocoa (called Series 2), which has been introduced to help revive cocoa output.[3] Hybrid cocoa offers several advantages over older cocoa varieties, namely, "Amazons" and "Amelonado." For example, hybrid cocoa yields more pods per tree; has more than two harvest seasons (compared with "Amelonado"); and has a shorter gestation period of three years as opposed to at least five years for older cocoa varieties.

Despite the benefits associated with hybrid cocoa, the majority of the farmers have not adopted it. According to Nyanteng (1993), only 10 percent of cocoa grown in Ghana is of the hybrid varieties. The adoption of hybrid cocoa entails increased costs in terms of acquisition of information, land, labor, chemical inputs, and machinery. In addition, there are differences in the social positions of the farmers that may influence their access to resources from acquaintances and cocoa institutions as well as their orientation to assume risk. Because the cocoa farmers possess varying amounts of the resources needed to use hybrid cocoa, they have responded differently to its introduction.

[3] The Cocoa Research Institute of Ghana (CRIG) carries out research into finding ways of boosting cocoa production (including the development of new cocoa varieties) whereas the Cocoa Services Division (CSD) is responsible for disseminating cocoa innovations to the farmers. CSD maintains offices in the cocoa growing areas where the farmers can visit to obtain information on cocoa innovations. According to CRIG, it began in the 1960s to introduce hybrid cocoa.

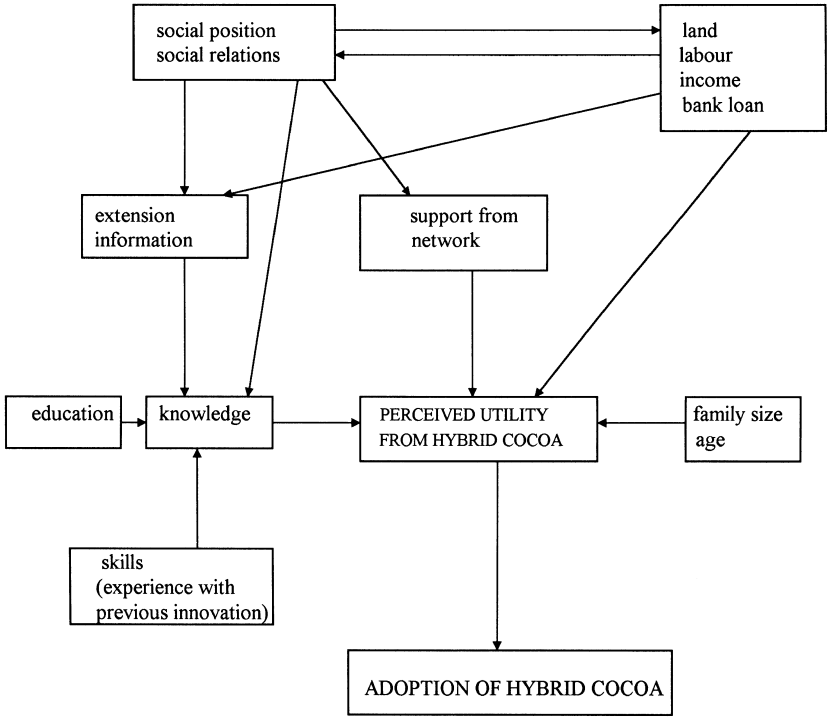

Figure 1. A model of adoption behavior.

The adoption of hybrid cocoa is conceptualized as presented in Figure 1. Farmers are assumed to make adoption decisions based on the objective of utility maximization. The main arguments in the utility function are profit and social reward.[4] Farmers face the choice between two technologies, i.e., hybrid and older cocoa varieties, and are assumed to adopt the technology that

[4] Through adoption, farmers obtain income to meet their needs as well as social obligations. Social reward includes the recognition and approval that society accords the farmer for being a successful innovator and for meeting social obligations. The amount of social obligations is defined as the number of relatives who depend on the farmer for their livelihood. In Ghana, the existence of the so-called extended family system coupled with the lack of an institutionalized welfare system means that the economically active people have to provide for the livelihood of many people. There seems to be no apparent trade-off between profit and social reward. If farmers adopts hybrid cocoa and are recognised as successful farmers, the underlying factor is that it is going to give them income.

offers the higher utility. The yield of hybrid cocoa is higher but uncertain. The uncertain yield of hybrid cocoa is due to the fact that it is affected much more easily by weather variations, i.e., objective uncertainty. The farmers are also not familiar with the capabilities of hybrid cocoa: it requires chemical inputs and new farming practices relating to, for instance, planting procedures, pruning, and spraying. This is termed subjective uncertainty. Access to information can help the farmers update their expectations of hybrid cocoa. The high-yielding capacity of hybrid cocoa can only be achieved if complementary practices are carried out (Hendersen and Jones, 1990).

The classical production factors that influence the adoption of hybrid crops are income (including savings and bank loan), land and labor—hired and family labor (see Feder et al., 1985). Income is needed to purchase the inputs required to cultivate hybrid cocoa. Note that in subsistence farming in Ghana, savings and income are low so bank loan is the most important source of farm finance (La-Anyane, 1986). Land provides the space for new planting and also makes the use of fixed inputs associated with hybrid crops more profitable (Arnon, 1987; Upton, 1987). Fixed costs in the adoption of hybrid cocoa involve money and time spent in searching for a given level of information from cocoa institutions; the time spent in making contacts with institutions and traders for the supply of complementary inputs; and the high cost of a mechanical spraying machine. Other things being equal, average fixed cost for the large-scale farmer is lower, and this makes adoption more profitable. Labor is required, among other things for land preparation, planting of seeds, spraying, pruning, and harvesting of crops. The higher genetic vulnerability of hybrid cocoa, e.g., the softness of its pods and the short stature of the trees, requires that the farmers give it increased husbandry.

Further, access to improved information is hypothesized to have a positive effect on the adoption of hybrid crops because it creates awareness about the existence of different forms of innovations and also allows the farmers to follow the new production procedures more appropriately. Economists have emphasized the importance of information obtained from extension agents, education, and skills (Birkhaeuser et al., 1991; Azhar, 1991; Lin, 1991) whereas sociologists have stressed information obtained via one's social networks, i.e., network information (Coleman et al., 1966;

Warriner and Trudy, 1992).[5] Extension agents are the primary source because hybrid cocoa is developed by the cocoa institutions. However, extension information involves costs, both in terms of the time and money spent in visiting the extension agents. The highly educated or skilled farmers will incur lower information cost because they are able to evaluate and understand information much more easily, and, hence, visit the extension agents less frequently. Farmers who lack the means to acquire information from extension agents or who are uneducated can rely on information from their social networks. Farmers often socialize at the market place, during communal gatherings, and at other similar occasions. Embedded in their discussions is often information related to farming. Farmers can make their farming decisions based on the information obtained via these informal sources. Because acquaintances who have not been successful with hybrid cocoa tend to confer negative signals, it is supposed that only farmers who are in a network of relation(s) with many previous successful adopters have access to a large network information and, therefore, will be more likely to adopt hybrid cocoa.

Besides, farmers obtain a variety of support, for instance, labor, farm machinery, and remittances form their social networks (e.g., Nowak, 1987; Warriner and Trudy, 1992). Labor obtained by cocoa farmers from their acquaintances is termed in Ghana as *nnoboa* or cooperative labor. A cooperative labor system involves an arrangement where a group of farmers take turns in helping each other on their farms. It does not involve any direct payment of wages to the cooperative members. Cooperative labor is cheaper than hired labor because the team spirit embodied in the cooperative system encourages members to work harder than they would if they were working on their own. The higher market wage for hired labor makes cooperative labor attractive, especially if the wage differential exceeds the marginal opportunity cost of cooperative labor. Farmers with access to cooperative labor are likely to incur a lower labor cost and thus, perceive the innovation to be more profitable. Other sources of support gained via social

[5] Social networks are the arrays of relationships that join individuals. The individual's action is embedded in, and affected by the (social) ties joining him and other people (Gravovetter, 1985). The support (including information) that individuals obtain from their social networks and the characteristics of their acquaintances constitute their *social capital* (Coleman, 1991). Sociologists have shown how individuals' behavior is influenced by social capital. This contrasts with the concept of *human capital* that economists have coined to refer to the educational level and entrepreneurship of individuals (Schultz, 1981).

networks, namely machinery (e.g., spraying machine and pruner), remittances, and occasional help obtained for spraying cocoa or harvesting crop may all contribute toward a reduction in production costs.

The social reward associated with the adoption of hybrid cocoa means that the social status of farmers plays an important role in the adoption decision. Status is defined with respect to variables such as royalty, leadership and membership in an organization.[6] If farmers are ranked into high, middle, and low social status categories, high status farmers are expected to adopt hybrid cocoa because of the increased recognition the society will confer on them by maintaining their leadership role. Higher status farmers also have a distinctive orientation toward risk taking due to their tendency to interact and/or hold discussions about a wide variety of issues with diverse people in the community. Similarly, lower status farmers are expected to innovate because they have little to lose, in terms of prestige, if hybrid cocoa should fail. They have been accorded the minimum status, and there is no possibility of losing any more status. Lower status groups may also show inclination to non-conformity (e.g., Featherstone, 1987). The middle status farmers will innovate less because of the reward of conformity (e.g., approval) or the punishment for non-conformity (e.g., ridicule and disapproval) that the society presents if the innovation fails. Thus we suppose that there is a U-shaped (quadratic) relationship between status and adoption (see Homans, 1974).

In addition to the above-mentioned variables, it is important to consider interactions and their impact on adoption decision because in the farming environment, farmers base their decisions on a combination of factors. Four possible *interactions*—farm size and bank loan; farm size and cooperative labor; farm size and network information (informal sources of information); and education and network information—are examined. Access to a bank loan is expected to increase strongly the chance of adoption among large-scale farmers rather than among small-scale farmers. With availability of space, access to inputs via a bank loan reduces the cost of adoption per hectare. Cooperative labor is expected to increase the likelihood of adoption for small-scale farmers more

[6] Here status has been defined to include only non-economic variables. In most sociological studies, status is operationalized to include wealth, education and consumption (see Gatrell and Gatrell, 1985). This definition has been avoided because there is no additional value gained by incorporating status in a model that already includes income and education.

than for large-scale farmers. Cooperative labor is cheaper, but it is also fraught with problems such as delays in searching for suitable farmers willing to form the cooperative and disputes arising from disagreements about the working abilities of members. Thus, small-scale farmers with less opportunity to hire labor will tend to rely on cooperative labor. The impact of network information on adoption is likely to be larger for small-scale farmers than for large-scale farmers. Small-scale farmers by reason of their limited resources tend to invest in their social networks rather than in extension services for information. The effect of network information on adoption is also expected to be of more importance for the least than for the highly educated farmers. The least educated farmers are more likely to invest in information acquisition from acquaintances and neighbors because they are less capable of analyzing information obtained from extension agents.

3. EMPIRICAL RESULTS

The data were obtained from an interview of 103 cocoa farmers in Suhum and Nkawkaw Districts in the Eastern Region of Ghana in 1992 and 1993. The Eastern Region is one of the oldest cocoa growing regions in Ghana. Fifty of the farmers were adopters of hybrid cocoa, whereas the other 53 farmers were non-adopters. The adopters involved farmers who adopted hybrid cocoa for the first time after November 1989. The farmers were selected by means of a simple random sample: they were those for whom cocoa production was an important activity, i.e., farmers with cocoa output of more than 60 kilograms per year and/or with a hybrid cocoa farm of at least 0.4 hectares. The farmers were interviewed to provide data about their socioeconomic situations within the year prior to their adoption of hybrid cocoa. We used these data to predict their adoption behavior. The operational definitions of the explanatory variables are given as follows (see also Boahene, 1995) in Table 1.

The average age of farmers is 53 years; adopters are, on average, seven years younger than non-adopters. The average number of years that the farmers have been involved in cocoa farming are 19 and 23 years for adopters and non-adopters, respectively. The existence of many old farmers in the cocoa industry is partly attributable to the system of inheritance. Land is mostly inherited by the oldest member of the family. The mean educational level of cocoa farmers is five years; adopters have, on average, six years of education compared with four years for non-adopters.

Table 1: Definition of Explanatory Variables

Extension	Number of contacts with extension agents per year
Education	Years of formal schooling completed by the farmer
Skill	Dummy variable, 1 if the farmer has used the innovation recommended by the Cocoa Research Institute of Ghana (CRIG) to control a cocoa pest called capsid, and otherwise 0
Previous adopters	Number of previous successful adopters in the farmer's network. It measures the level of positively-oriented informal information available to the farmer
Land	Hectares of farmland
Bank loan	Dummy variable, 1 if the farmer receives a bank loan, otherwise 0
Hired labor	Man/days of hired labor per hectare
Family labor	Man/days of family labor per hectare
Age	Age of the farmer (in years)
Network support	Amount of social support received from acquaintances[a]
Status	Dummy variable, 0, 1 and 2 if the farmer holds a low, middle, or high social status, respectively[b]
Cooperative labor	Number of cooperative laborers per hectare
Family size	Number of relatives who depend on the farmer for their livelihood. It measures the level of social obligation that the farmer has to meet
Income	Amount of the farmer's income (from cocoa and non-cocoa activities)

[a] The various sources of assistance considered in creating the variable are (1) support obtained in spraying the farm, (2) loan obtained from network, (3) ability to discuss with acquaintances issues about cocoa production, (4) support obtained for harvesting the crop (5) ability to borrow a spraying machine. It is assumed that the support given by educated acquaintances is more valuable because they are thought to be well informed about improved methods of production. The farm size of acquaintances is also important because it affects the amount of support provided and the frequency at which support is given. Educational support obtained by the farmer is computed by the following formula (*EDS*):

$$EDS = \sum_{h} (E_{hj} + 7)\,(S_{hj} + 1) \tag{1}$$

where E_{hj} = educational level of network member h of respondent j, S_{hj} = support from network member h to respondent j and S is defined as a dummy variable, i.e., 1 if support is given, and otherwise 0. The educational level of the acquaintances ranges from zero to 16; we add seven to the education of every acquaintance so that the *EDS* of the highly educated acquaintance is about a factor of three. Farm support obtained by the farmer is computed similarly, taking the farm sizes rather than the educational level of network members (*FMS*):

$$FMS = \sum_{h} (F_{hj} + 1)\,(S_{hj} + 1) \tag{2}$$

where F_{hj} = farm size of network member h of respondent j, and h is restricted to network members who are farmers. The farm size of acquaintances ranges from three to 16 hectares. Thus, we add one to the farm size of each acquaintance so that the modified farm size for the largst-scale farmer is about four times bigger than that of the smallest-scale farmer. We then calculate the z-score for *EDS* and *FMS*, and add the two scores to form the variable NETWORK SUPPORT. It should be observed that in addition to NETWORK SUPPORT, STATUS, PREVIOUS ADOPTERS, and COOPERATIVE LABOR have been used as indicators of social networks.

[b] Farmers were asked whether or not they held positions considered socially important in the community, namely (1) a board member of the village political organization, (2) chief farmer, (3) a member of the village development committee, (4) chief/queen, (5) members of royal families (including sub-chiefs), (6) head of clan, and (7) local priest. The positions (1) to (3) are defined as having high status. These positions may be regarded as achieved status, leading to more interaction with the youth, the educated and people in power. The positions (4) to (7) are defined as middle status. They may be regarded as ascribed status positions. Unlike farmers of achieved status, ascribed status farmers normally discuss issues concerning norms and traditions. Farmers with none of these positions are defined as low status.

Availability of a bank loan to farmers is low. Less than 30 percent of the farmers are recipients of bank credit. The banks find agriculture, especially small-scale farming, a risky venture because it is prone to the vagaries of weather and to pests and diseases. Compared with trading, farming takes a longer time to recoup the money invested. Thus, the banks are less inclined to offer loans to farmers. However, 42 percent of adopters compared with only 17 percent of non-adopters receive a bank loan. In terms of land available for new planting, the average land size for an adopter is 3.5 hectares and, for a non-adopter, is 3.2 hectares. Whether or not these personal, social, and economic characteristics are able to influence farmers' decision to adopt hybrid cocoa as predicted by the theoretical model is an empirical issue and a subject of interest in the following section.

A logistic regression model is used to examine the factors which distinguish adopters of hybrid cocoa from non-adopters (Hosmer and Lemeshow, 1989). Table 2 presents parameter estimates obtained from three logistic regression models. In testing the hypotheses derived from the theoretical model, it is necessary to control the influences of other variables. Thus, Table 2, Model 1 includes all the variables that are considered to be important in the adoption decision. Given the large number of independent variables relative to observations in Model 1, a backward stepwise selection procedure has been carried out. Model 2 drops INCOME, SKILL, LAND, NETWORK SUPPORT, and FAMILY LABOR. When these variables are eliminated from Model 2, BANK LOAN and HIRED LABOR become significant at the one and five percentage level, respectively. Model 3 contains all the variables in Model 2 except STATUS, $(\text{STATUS})^2$ and FAMILY SIZE. It is the final model that is used for explaining the adoption decision. It includes only variables that are significant at 10 percent or less.

Table 2 (Model 3) shows that there is a positive relationship between access to a bank loan and the decision to adopt hybrid cocoa. Agricultural loans are given mainly by the Agricultural Development Bank and the Rural Bank. Few farmers obtain loans from private money lenders[7] because of the high interest rate

[7] Private lenders are individuals who lend money to people for a fee (interest). They are not related to the recipients of the loans. Private money lending is the earliest form of credit for the Ghanaian farmers. Money lenders are easily approachable, not bureaucratic and ready to lend at short notice. However, their high interest rate tends to plunge farmers into indebtedness. Also, they indulge in expropriation of pledged objects and unfortunate farmers can lose most of their cocoa farms and property.

Table 2: A Summary of the General Logistic Regression Model for Adoption ($n = 103$)

Variables	Model 1	Model 2	Model 3
Extension (1–7)	0.50**	0.53**	0.47**
	(0.26)	(0.25)	(0.24)
Income (kgs)	0.0011		
	(0.0012)		
Bank loan (0–1)	1.51**	1.56***	1.49***
	(0.67)	(0.62)	(0.59)
Family size (no. of people)	−0.12	−0.09	
	(0.15)	(0.14)	
Age (years)	−0.05**	−0.05**	−0.05**
	(0.02)	(0.02)	(0.02)
Education (years)	0.111*	0.103*	0.116**
	(0.075)	(0.066)	(0.063)
Hired labor (persons per hectare)	0.041*	0.041**	0.042**
	(0.025)	(0.020)	(0.019)
Skill (0,1)	0.21		
	(0.73)		
Land (hectares)	−0.08		
	(0.19)		
Cooperative labor (0–1.3)	2.72***	2.72***	2.69***
	(1.00)	(0.92)	(0.92)
Previous adopters (no. of people)	0.81***	0.76***	0.75***
	(0.31)	0.28	(0.26)
Network support (0–9.3)	0.06		
	(0.17)		
Family labor (persons per hectare)	0.020		
	(0.026)		
Status (0,1,2)	−0.68	−0.58	
	(0.57)	(0.53)	
$(\text{Status})^2$	0.76	0.72	
	(0.74)	(0.72)	
Intercept	−5.41	−4.80	−5.01
	(2.32)	(2.13)	(2.03)
−2 Log Likelihood	93.06	94.74	96.95
McFaden R^2	0.35	0.33	0.32

* Represents significance at 10%, ** 5%, and *** 1% respectively; tested at one-tail probability.

Standard errors are in parentheses.

Variables are indicated with their units or range.

involved (up to 100 percent of the amount lent). The high interest rate charged by the money lender, however, serves as a guarantee against delays in loan repayment. Farmers can also receive remittances from relatives in the urban areas, but such cash assistance is limited and tends to be used to finance consumption. Farmers' own income has no positive significant effect on adoption (Table 2, Model 1). The insignificant effect of farmers' income of the adoption decision might be due to the low level of cocoa output and the limited income obtained from off-farm activities.

Farmers' educational level, the number of previous successful adopters in their network and the number of contacts with extension agents have a significant positive impact on the decision to adopt hybrid cocoa (Table 2). There is a positive correlation between visits made by the extension agents and farmers' earlier level of cocoa output ($r = 0.27$, $P < 0.05$). Thus, the larger and prominent farmers tend to attract the attention of the extension agents. This confirms existing research that the target farmers, i.e., farmers who are selected for training by the extension agents, in the poor countries are mainly wealthy farmers (e.g., Freeman, 1985). It is cost effective for the extension agents to train such farmers because they already possess some level of improved farming knowledge.

There is also a negative correlation between the number of successful adopters in the farmers' network and the number of visits made to the extension agents ($r = -0.34$, $P < 0.01$). This suggests that farmers tend to substitute information acquired from their acquaintances for information obtained from the extension agents. Studies in communication sociology, however, stress that information obtained from acquaintances and formal sources of information are not substitutes but complementary (see Rogers, 1983; Long, 1992). It is argued that the awareness of an innovation via information obtained from friends and acquaintances may encourage the individual to learn more about the innovation by searching for information through formal sources. This is not particularly the case in the cocoa areas of Ghana where farmers do not have enough money to invest in information search, and more importantly, where, due to low education, knowledge accumulated from acquaintances tends to be valued highly.

The size of farmland is not an important variable in distinguishing an adopter of hybrid cocoa from a non-adopter (Table 2, Model 1). However, the interaction of land size and a bank loan has a significant positive impact on adoption (Table 3, Model 2).

It means that large land size is only important in the adoption decision if farmers have access to a bank loan. In contrast, the interaction between land size and the number of successful adopters in the farmers' network is negative and significant (Table 3, Model 4). This means that the effect of information obtained from informal relations is larger for the small-scale farmers than for the large-scale farmers. The support from social relations has a stronger effect on adoption for small-scale farmers, presumably because their other resources are not sufficient. Since the Cocoa Services Division faces organizational and logistic problems which hamper the frequency and quality of visits by extension agents to farmers, it seems prudent for the poor farmers to develop their informal sources of information.

The use of family labour and experience with previous innovation have no significant effect on the decision to adopt hybrid cocoa (Table 2, Model 1). Family labor used to be an important source of labor for the Ghanaian cocoa farmer. Killick (1966) suggests that the cocoa industry is essentially run by those who manage their farms with the help of their families. Similarly, Hill (1970) remarks that farmers never "waste" their savings on farm labor employment until, with the help of their families, they have established sufficiently produce-bearing cocoa farms to reward their labor with a share of their cocoa income. However, with the aging of the rural population and especially the migration of the youth to the cities in search of industrial jobs, the importance of family labor in cocoa production has declined. Access to hired and cooperative labor has a significant positive impact on the decision to adopt hybrid cocoa (Table 2, Model 3). Moreover, the interaction of cooperative labor and land size on adoption is negative and significant (Table 3, Model 3). It indicates that the effect of cooperative labor on adoption is greater for smaller-scale farmers than large-scale farmers. The high cost of hired labor explains small-scale farmers' reliance on cooperative labor.

Network support, family size, and social status do not have a significant influence on adoption (see Table 2, Models 1 and 2). However, social status is positively related to access to a bank loan ($r = 0.33$, $P < 0.01$), and a bank loan has a positive effect on the decision to adopt hybrid cocoa. Younger farmers with their longer planning horizons, are more likely to adopt the hybrid cocoa (Table 2, Model 3).

Table 3: Logistic Regression Model for Adoption (including interaction terms) $n = 103$

	Unstandardized coefficients			
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Extension (1–7)	0.46*	0.47*	0.44**	0.47*
	(0.24)	(0.25)	(0.25)	(0.25)
Bank Loan (1–2)	1.54**	1.81**	1.49**	1.65**
	(0.60)	(0.65)	(0.61)	(0.62)
Age of farmer (years)	−0.046*	−0.045*	−0.045*	−0.046*
	(0.022)	(0.022)	(0.022)	(0.022)
Education (years)	0.12*	0.13*	0.14**	0.12*
	(0.06)	(0.07)	(0.07)	(0.07)
Cooperative labor (0–1.3)	2.75**	2.85**	2.95**	2.85**
	(0.93)	(0.99)	(1.00)	(1.00)
Hired labor (persons per hectare)	0.044*	0.047*	0.034*	0.047*
	(0.020)	(0.022)	(0.022)	(0.022)
Previous adopters (no. of persons)	0.78**	0.75**	0.78**	0.89**
	(0.26)	(0.26)	(0.26)	(0.29)
Land (hectares)		0.16	0.021	0.023
		(0.21)	(0.174)	(0.177)
INT^1	−0.012			
	(0.019)			
INT^2		1.08*		
		(0.59)		
INT^3			−0.65*	
			(0.49)	
INT^4				−0.28*
				(0.14)
Intercept	−5.22	−6.30	−5.49	−5.83
	(2.07)	(2.24)	(2.17)	(2.21)
−2 Log Likelihood	96.58	93.10	95.09	92.42
McFadden R^2	0.32	0.35	0.33	0.35

* Represents significance at 10%, ** 5%, respectively; tested at one-tail probability.

Standard errors are in parentheses.

Variables are indicated with their units or range.

INT^1 = product interaction term of education and number of successful adopters in the network.

INT^2 = product interaction term of bank loan and land size.

INT^3 = product interaction term of land size and cooperative labor.

INT^4 = product interaction term of land size and number of successful adopters in the network.

NB: interaction terms are computed as product variables of variables with zero mean.

4. CONCLUSIONS AND POLICY IMPLICATIONS

The study has shown that the adoption of hybrid cocoa is a process incorporating different mechanisms and factors—both economic and sociological. Factors, such as bank loans and hired labor, have significant positive impact on adoption. Also, education and the amount of information accumulated from extension agents are important in determining whether or not a farmer becomes an adopter. However, access to land, income, and skills have no significant effect on adoption. The generally low income from farm and off-farm activities may explain the low impact of farmers' income on adoption. Skills have not been important in adoption decision probably, because it is poorly operationalized. We define skills to include mainly farmers who have previously adopted the recommendation of the cocoa institutions to control the common cocoa pests, capsid. The fact that the majority of the predicted effects are statistically significant provides support for the assumption of profit orientation underlying the theoretical model.

Some of the resources obtained from the farmers' social networks, for instance, cooperative labor and network information, are important in influencing the adoption of hybrid cocoa. The effect of these resources on adoption is higher for smaller-scale farmers than for larger-scale farmers. Small-scale farmers gain more from their networks because they do not have access to other resources. The availability of these forms of social support for small-scale farmers partly explains why many of them choose for hybrid cocoa. Besides social support, the role of farmers' social status in adoption was considered. Social status, operationalized independently of economic status, has only an indirect effect on adoption: it influences access to a bank loan, an important variable in adoption decision.

According to economic theory, the chance of farmers adopting hybrid cocoa should increase with farm size since adoption involves fixed costs. The sources of fixed costs include cost (monetary and time) incurred in acquiring information from extension agents and the cost of a mechanical spraying machine. In this study, the inclusion of social support in the adoption model has shown that these economic constraints can be overcome to facilitate adoption by farmers, irrespective of their scale of operation. Thus, an integrated approach helps avoid the limitations often associated with mono-disciplinary models in innovation adoption.

The findings of this study have policy implications. It is well-known that the government does not have enough money to provide technical advice and credit for all farmers in the cocoa industry, and the majority of the farmers also do not earn enough income to buy their own inputs. To ensure the efficient use of resources and hence revive the cocoa industry, there is the need to devise a framework in which the resources obtained from the networks and those provided by the government can be integrated. It is important to identify the target farmers (i.e., knowledgeable farmers) and provide them with the resources to enable them help the farmers who depend on them for support. This is different from the so-called trickle-down development strategy because the target farmers in this case, are farmers who have a special status and have demonstrated over the years that they can help small-scale farmers via cooperative labor and network information. The cooperative labor system is an arrangement where a group of farmers take turns in helping each other on their farms.

In a locality where there is no clear target farmer, the members of the cooperative labor system can be given the resources that could have gone to the target farmer. The cooperative members can arrange with the extension agents to meet at certain times on the farm of a member to discuss farming problems. If inputs are given to the members, the common aspirations and experiences that the members share with each other are likely to increase their trust and contribute to the efficient sharing of inputs.[8] The formation of these cooperative units may even help the farmers become more creditworthy because the members can serve as guarantors and prevail upon members to make prompt repayment of loans. Financial incentives given to the cooperative unit can help transform the cooperative labor system into a viable labor system. The cooperative system lasts for only one farming season. Normally, it is dissolved nearing the end of a farming season because poor members leave to assist landowners who can help them acquire inputs. Disagreements among members about the working abilities of some participants is also an influential factor. Thus, at the beginning of every farming season, farmers have to spend a great deal of time in finding fellow farmers who are willing to form the cooperative system. Provision of inputs for

[8] Inputs, for example, spraying machines and pruners kept at the Cocoa Services Division offices in the villages tend to break down often since no single farmer has rights over them, and as a result nobody ensures that they are kept in good condition after use.

the cooperative system can help raise its life span as well as its productivity.

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