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Factors Influencing Farmer-to-Farmer Transfer of an Improved Cowpea Variety in Kano State, Nigeria

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Abstract
Diffusion of improved technologies among small-scale farmers, especially where formal methods and market mechanisms are inefficient, can be enhanced through the participation of farmers. Unfortunately, formal methods of disseminating improved seed in most African countries have not taken advantage of the farmers' traditional transfer methods. This article deals with the role of farmer-to-farmer transfer and dissemination of an improved cowpea seed variety in Nigeria. Using household and farm level data from 133 respondents, the study adopts a logit model to investigate the determinants of the farmers' decision to transfer the new seed variety to other farmers. Area of improved cowpea cultivated, yield, market price of seed, use of pesticides and threshing quality were found to be significant variables affecting farmers' decision to transfer the improved cowpea variety.

Keywords: Farmer-to-farmer, seed, dissemination, cowpea, logit, Nigeria

1 Introduction

In most parts of Africa, the transfer of technology from agricultural research institutions to small-scale farmers is carried out largely by the public agricultural extension services and to a lesser extent by the private sector. With declining project support funds, budgetary constraints, and dwindling state budgets, the public extension services have become even less efficient in delivering agricultural information and in transferring new technologies. Also, with the rationalization of government extension departments, the extension to farmer ratios have widened, posing further constraints in the delivery of extension messages. The private sector has not responded adequately to fill up the gap in service provision to small-scale farmers created by the withdrawal of the state. This is due to the lack of sufficient trained personnel, unprofitability of providing services, the complex farming systems in which farmers operate and farmers inability to pay for the services (Kormawa *et al.*, 2001).

In the diffusion process, traditional dissemination methods have been found to be vital in technology transfer to farmers, especially for seed varieties, and improved livestock breeds that are usually introduced by the public or private sector (Cromwell, 1990). Within the process of participatory technology development attempts have been made to

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build on farmer-based knowledge (Ashby, 1990). These include the design of extension methods that would have greater impact on technology dissemination and transfer of new production inputs and methods. Recourse to the use of farmer-to-farmer communication is based on evidence (Grandstaff and Grandstaff, 1986) that even in areas were social organisation and infrastructure exists, farmers prefer their fellow farmers as their primary information source. Feder and Slade (1985), reveal that while farmers in India without access to formal extension service use farmer-to-farmer communication, most farmers also preferred fellow farmers as their major source of information were the Training and Visit extension system exists. Communication among farmers is an important factor in feeding local farmer experimentation; furthering exchange, encouraging adaptations to improved technologies and strengthening local capacity for self managed change. Fujisaka and Moock (1992) presented cases that illustrate how "farmer science" and "formal science" can be complementary in the development of more sustainable rice systems in the Philippines. Unfortunately, formal extension methods in most African countries have not taken advantage of the farmers' traditional technology transfer methods.

A growing amount of literature (Adesina and Bardu-Forson, 1995) exists on the influence of technology characteristics on the rate of adoption. Adesina and Zinnah (1990) show that technology characteristics determine their diffusion and a recent study by Negatu and Parikh (1999) also indicate that technology attributes and farmers perceptions influence the rate and speed of adoption. These studies have considered formal extension systems as an exogenous variable affecting the adoption of improved technologies. However, new insights can be gained as to whether farmer-to-farmer communication (i.e. the informal diffusion process) is also driven by economic considerations, sociological factors and technology-specific attributes and perceptions. As demand for improved seed and inputs increase, the need to strengthen this process and how it would lead to increasing adoption rates of improved technology becomes an important challenge to agricultural development.

This paper addresses the role of farmer-to-farmer transfer and dissemination of an improved cowpea variety IT90K-277-2 among farmers in Nigeria. Specifically, the objective of the paper is to determine the effect of economic, social and technological attributes and perceptions on farmers' decisions or willingness to transfer the improved cowpea variety to other farmers. This is necessary to inform researchers, extension planners, as well as agricultural NGOs on the importance of this method of technology transfer and dissemination.

1.1 Farmer-to-farmer diffusion of improved cowpea seed in Nigeria

Formal seed production and distribution systems in Nigeria are still not well established. Even the developing private seed sector tends to concentrate on maize and other cereals. In most cases, extension support and materials are specifically targeted only to these crops. This poses a major impediment to the adoption of improved cowpea seed among farming communities. In the technology development and adoption chain, gaps usually exist between technology developers, adopters, and even between technology leaders and followers. Where a technology has to be adapted to farmers' circumstances and local conditions, there is narrower gap with the farmer-to-farmer technology transfer process. This is because farmers are involved in testing, watching and circulating information and therefore a greater chance of adoption is ensured. In the effort to bridge the gap between technology generation and adoption, the International Institute of Tropical Agriculture (IITA), Nigeria adopted a pro-active approach in some community-based seed production projects in West Africa (International Institute of Tropical Agriculture (IITA), 2000). One of the projects was concerned with providing support for cowpea seed production and the dissemination of improved cowpea seed among small-scale farmers in northern Nigeria.

In collaboration with the Institute for Agricultural Research (IAR), Zaria, and the Kano State Agricultural and Rural Development Authority (KNARDA), IITA began a cowpea seed production project in 1997, with initial funding from the German Agency for Technical Cooperation (GTZ). A demonstration approach was used to show the advantages of an improved cowpea variety - IT 90K-277-2. In the first year, a group of 50 farmers received 3 kg of breeder seed of the improved variety. The fields of these farmers served as demonstration plots to other farmers. An additional 51 farmers joined the group in the second year and 50 more in the third year. Each of these farmers received 3 kg of the pure seeds for planting. During these years (1997/1999), the number of farmers that grew and transferred the improved seed to other farmers, through seed sale or gift increased significantly. Table 1 shows how farmers disposed of their cowpea harvests in 1998 and 1999. Among the disposal methods, seed sale was the most important. The average quantity of cowpea sold as grains per farmer was 174 kg in 1998 representing 80 percent of total harvest. Quantity of seed sold per farmer decreased to about 163 kg in 1999 representing 70 percent of total harvest. Grain saved for household consumption or seed for next season planting ranged between 25 kg in 1998 and 31 kg in 1999, representing 11 and 15 percent of total harvest respectively. It is typical for small holders to save part of the harvest for subsequent planting season. Compared to seed sale, production for consumption purposes was less important. Farmers gave away seed to neighbours or relatives as gift. This is an important method of seed transfer among farmers in the study area. Average grain quantities given away increased slightly in 1999 from 21 kg to about 28 kg per farmer.

The number of farmers actually receiving the improved seed from farmers participating in the project is shown in Figure 1. The figure indicates that within 3 years about 4104 farmers received seed through participating farmers. In terms of cumulative number of adopters, the trend of recipient farmers in the years following the launching of the project follows the usual S-shaped curve over time (Rogers, 1995). Few farmers would be willing to try a new seed variety at the initial stage. As they learn more about the variety, more farmers will demand the variety. The declining number of recipients during the third year implies that recipient farmers may be saving seed from previous years. Also, the demand for the new seed by interested farmers within the immediate vicinity of project locations may have been satisfied. Studies elsewhere have shown that small-scale farmers generally prefer to use their own seed, as these are readily available at planting time, no expense is incurred and the farmer is assured of the seed source and quality.

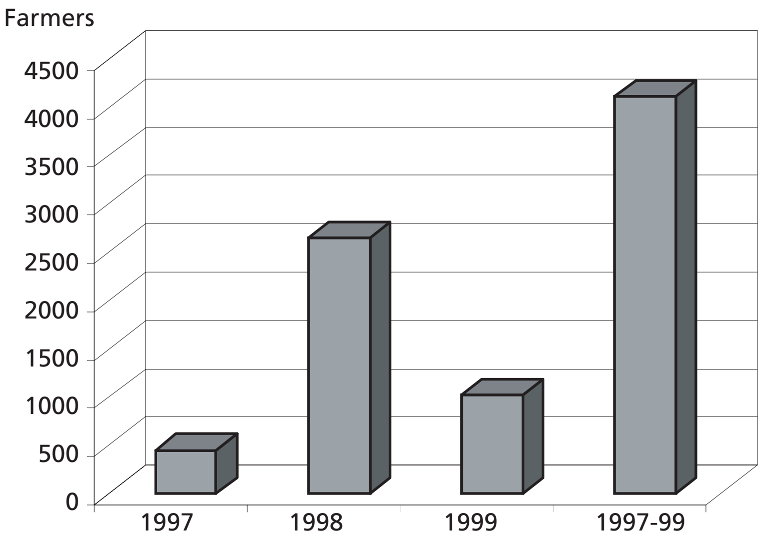
Table 1: Distribution of farmers Cowpea (IT90K-277-2) distribution in Nigeria

Year	*Household Food*		*Given as Gift*		*Sold as Seed*		*Total Disposal*
	Average (kg)	*%*	*Average (kg)*	*%*	*Average (kg)*	*%*	*(tonnes)*
1998	24.74	11.37	21.35	8.58	174.05	80.05	28,718
1999	31.31	15.83	28.09	14.21	162.88	69.96	28,918

N=133

Source: Cowpea farmers' survey 1999

Figure 1: Number of farmers receiving IT90K-277-2 seeds in northern Nigeria.



At the village level, when farmers have to buy seed, they prefer to buy from another farmer in the community. This provides major advantages for informal seed diffusion, especially for self-fertilizing crops, such as cowpea. This has been enhanced, as a result of better storage methods developed through research, enabling cowpea seed to be stored for longer periods without deterioration.

1.2 Theories of Agricultural Technology Diffusion and Adoption

Three theoretical models exist in the explanation of diffusion and adoption behaviour by farmers. These models are categorised into (a) the innovation-diffusion model (b) the economic constraints model and (c) the technology characteristics users' model (NEGATU and PARIKH, 1999). The innovation-diffusion or technology of transfer model arises from the work of ROGERS (1995). The model assumes that a technology is transferred from its source (the research institutes) to the end-users through agent medium (extension systems) and its diffusion in potential user communities depends primarily on the personal characteristics of the potential individual user. The important issue with respect to this model is that technology is appropriate for use provided that it is not hindered by the lack of effective formal and/or informal communication methods.

Emanating from the pioneering work of HAYAMI and RUTTAN (1971), the economic constraints model (or factor endowment model), assumes that the distribution of resource endowments among potential users in a country or region determines the pattern of technological adoption. The model further assumes that market prices reflect the relative factor scarcities in well functioning markets. The price ratio at the village level between modern inputs and marketable surplus must be low enough for their use to be profitable. Incentives to increase production and market surplus using improved inputs are reduced if remunerative output prices are not transmitted to farmers especially where physical barriers and transportation costs are high.

Complementary to the first two models, the relatively more recent technology characteristics users' model assumes that the characteristics of a technology, socio-economic and institutional contexts are the dominant determining factors in the adoption decision and diffusion process (SCOONES and THOMSON, 1994). In this model the perception of potential adopters as well as the characteristics of the technology are important determinants for adoption decisions and diffusion of the technology. This paper is interested in the institutionalisation of research and extension strategies that will facilitate the participation of farmers and other stakeholders in the development process. Therefore, the basic tenets of all three models are important for this paper since farmer-to-farmer communication is treated as an endogenous variable that can be influenced by economic and social/personal characteristics.

2 Methodology

2.1 Data source

Data on which the empirical model is based on were collected from 133 farm households drawn across 21 villages in eight Local Government Areas (LGAs) of Kano State. Improved cowpea seed had been previously introduced to all the villages under a cowpea seed production and dissemination project. The survey households were selected using a stratified random sampling technique. The sample comprised of project and non-project participating farming households. A pre-tested structured questionnaire was used to collect data from the sampled households. The survey was conducted from November to December 1999. The questionnaire was administered to the male household head.

Evaluation of farmers' transfer of the improved seed to others was posed as a dichotomous choice question. A household head was defined for this study as the participating farmer in the project. All respondents were male as it is not common for women to participate in agricultural activities beyond threshing and food processing, because of cultural reasons.

2.2 Conceptual framework

Farmer-to-farmer technology dissemination process can be viewed as an informal market where technology passes from supplying to recipient farmers (GRISLEY, 1994). The seed production plots on participating farmers' fields served as demonstration sites for others who were not directly involved in the project. This allowed farmers, researchers, and extension agents to evaluate the new seed variety for wider dissemination. Within the process, farmers adopt the technology and transfer to others. Non-participating farmers also visited the improved seed plots for evaluation purposes. Through these visits and interactions among participating and non-participating farmers, more non-project farmers became interested in acquiring the seed for planting in subsequent seasons. The new cowpea seed variety is being popularised among farmers through this farmer-to-farmer transfer approach. Given that the role of the extension service in the transfer of seed is very limited and that the supply of technology is fixed, further investigation of the process became of interest. Seed technology, unlike other forms of innovation (especially information), is tangible and usually in fixed quantities. Therefore, we hypothesize that transfer to others will depend on farmer specific characteristics, market price, total cultivated area with the improved seed, as well as farmer perception on the superiority of the variety. Apart from price factors, farmers derive utility from transferring seeds to relatives or friend as gifts. Also, because small-scale farmers usually store part of the harvest for household consumption, perceptions on consumption qualities will also affect transfer.

2.3 Modelling farmer to farmer seed transfer

In assessing the factors that determine farmers' decisions to transfer, we require a model that deals with the dichotomous dependent variable "transferred seed or not transferred." This behavioural dependent variable can be used to examine the relationship with the independent variables. Such models cannot be estimated by either multiple regression or the ordinary least square (OLS) techniques. Multiple regression technique results in invalid parameter estimates and wrong magnitude of the effects of the independent variables on the dependent variables. In the case of OLS, assumptions that the variances of the error terms are constant and not correlated with the level of independent variables are violated. Consequently, four commonly used approaches to estimate such models are: the linear probability model (LPM), logit model, probit model, and the Tobit model (GUJARATI, 1995). Like the OLS technique, the LPM is also plagued by several problems and is not generally recommended. The LPM provides predicted values that may fall outside the 0-1 intervals, thus violating the assumption of probability. The remaining model types give maximum likelihood estimators and overcome most of the shortcomings of linear probability model, by providing consistent and efficient estimates.

Among the three other techniques proposed, we opted for the logit model framework as described by MADDALA (1983) and GUJARATI (1995). This model has been applied in a similar study (GRISLEY, 1994) and has been found to be efficient in explaining such dichotomous decision variables. In formulating the model, we assumed that P_i is the observed response of farmer i, (i.e. $P_i = 1$ for transferring, otherwise $P_i = 0$), the decision to transfer by an i^{th} farmer depends on X_i, which is a vector of factors representing the farmer-specific, economic, social, cowpea attribute, and farmers' perceptions. The disturbance term is represented by (ξ) and assumed to have a mean equal to zero. Conceptually, the decision model can be stated as follows (equation 1):

$$\ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \sum_{j=1}^{n} \beta_j X_{ji} + \xi \tag{1}$$

The empirical model specifying the transfer of the improved seed is implicitly stated in equation 2. The dependent variable is represented by the natural log of the probability to transfer seed P_i to another farmer or the probability not to transfer seed $(1 - P_i)$. The error term is assumed to be independently distributed over the sample and accounts for the unobservable variables and characteristics of the surveyed households.

$$\begin{aligned}\ln\left(\frac{P_i}{1-P_i}\right) \quad = \quad & (\beta_0, \beta_1 St, \beta_2 Fl, \beta_3 Mr, \beta_4 Mk, \beta_5 Ar, \beta_6 Yl, \beta_7 Ct, \beta_8 Sr, \beta_9 Ap, \\ & \beta_{10} Tp, \beta_{11} Tq, \beta_{12} Bq, \xi)\end{aligned} \tag{2}$$

Explanation of these variables is provided in Table 2. The independent variables are categorised into four, namely: sociological, economic, complementary or substitute inputs and perception variables. The sociological variables include membership of social organisations (Mr), the use of family labour in cowpea production (Fl), and status of farmer (St). The economic variables included in the model are market price (Mk) of improved cowpea, yield of improved cowpea (Yl), area cultivated of improved cowpea (Ar), number of cattle owned by farmer (Ct), number of small ruminants owned by farmer (Sr) and transportation costs (Tp). The complementary inputs variable includes use of agrochemicals (Ap) in cowpea production while the perception variables include threshing quality (Tq) and cooking (Bq) quality of improved cowpea variety as perceived by the farmers in the study area. In formulating the model to include the above variables, various working hypotheses were taken into consideration. These are discussed in the following paragraphs.

Farmers usually belong to various types of social organisation and also form part of various networks. Membership in social organisations (Mr) implies that farmers meet regularly and allow discussions on farm issues. Therefore membership in social organisations may lead to sharing of information on agricultural inputs; thus (Mr) is expected to positively affect farmers' decision to transfer improved cowpea seeds. Use of family labour (Fl) in cowpea production is also postulated to have a positive effect on the

Table 2: Description and means of variables in the model

Variable	*Unit*	*Description*	*Mean*	*SD*
Sociological				
St	Binary	Farmer social status, 1 if titled,0 otherwise	0.2879	0.4545
Mr	Binary	Member of organisation, yes=1; otherwise 0	0.4384	0.4385
Fl	Number	Household members who work on the farm	3.030	3.092
Economic				
Mk	Number	Cowpea market price (₦/100kg)	8259.71	13189.98
Ar	Number	Total cowpea area harvested (ha)	0.4823	0.5292
Yl	Number	Yield per hectare of IT90K-277-2 in kg	399.06	693.61
Tp	Number	Transport cost to market (₦)	4.150	2.10
Ct	Number	Cattle owned by household head	6.815	10.52
Sr	Number	Small ruminants owned by household head	10.050	9.44
Complementary				
Ap	Binary	Applied pesticide, yes = 1; otherwise 0	0.6667	0.4732
Perception				
Tq	Binary	Threshing, 1 = better than local, 0 otherwise	0.8400	0.3681
Bq	Binary	Boiling, 1 = better than local, 0 otherwise	0.8487	0.3598

N=133

dissemination of improved cowpea to other farmers. Status of farmer (St) is defined as respondents who have farming as their primary occupation but are also considered men of status in the community (e.g. "Sarkin Norma", master farmer). This variable is expected to have a positive influence on farmers' decision to transfer seed.

Unlike Grisley (1994), who used total crop area as a measure of farm size, an indication of homestead wealth and as a proxy of social status and influence within the community, we use the same variable as an economic variable in this study. Area cultivated of the improved cowpea seed is expected to have a positive sign, as farmers are likely to increase the area cultivated (through leasing or sharecropping) if they like the cowpea variety. Traditionally, leasing or sharecropping for cultivation requires payment in kind such as giving out a certain proportion of output to the landlord. This variable (Ar) is expected to have a positive effect on farmers' decisions to give out improved cowpea seeds to other farmers. Yield from plots planted with improved cowpea seed will also positively influence farmers' propensity to transfer seed to others. The comparative yield advantage of improved (Yl) over local cowpea seed was postulated to affect farmers' decision to transfer seeds positively. This is based on the assumption that the better the yield of the improved seed over the local variety, the higher the demand for the seed from other farmers in the community. Cowpea is considered a commercial crop in the study area while crops like millet are produced for home consumption. It is therefore postulated that the demand for improved cowpea seeds will increase because of its high value on the market. A positive sign is expected for the variable (Mk). Hence the higher the market prices of the improved cowpea in the market the greater the likelihood of the farmer to disseminate the seeds to other farmers. In contrast, transportation costs (Tp) is postulated to have a negative effect on farmers' decisions to disseminate improved cowpea seeds to fellow farmers. Cattle and small ruminants are stores of wealth in African agriculture. It is therefore postulated that the higher the number of cattle and small ruminants owned the wealthier the farmer and the greater the likelihood of transferring improved cowpea seeds to other farmers. Hence it is expected that the coefficients of the variables for Ct and Sr will have a positive effect on farmers' decision to transfer improved cowpea seeds.

An important source of risk in cowpea production is damage from pests. This is of particular concern to farmers especially because cowpea is a commercially oriented crop with informal quality standards in the market. Pest damage directly affects the proportion of crop marketed and thus a farmers' profit. Hence a farmer's pest management decision is directed towards reducing damage from pest through the use of pesticides. Farmers who use pesticides to produce improved cowpea seeds may derive higher yield benefits but may not have the propensity to share this new innovation with other farmers, friends or relatives because of additional expenditure on pesticides. The coefficient of the variable Ap is postulated to have a negative influence on farmers' decision to transfer improved cowpea seeds to other farmers.

Farmers are likely to spread the news of a new crop variety to other farmers if they perceive positive post harvest qualities in the variety. The perception variables included in the model are threshing quality (Tq) and cooking quality (Bq). Following ADESINA and ZINNAH (1990) we also postulate that ease of threshing and cooking are positively related to farmers' decisions to give away improved cowpea seeds to their fellow farmers.

3 Results and Discussions

The maximum likelihood algorithm of the $LIMDEP$ package was used to estimate the empirical model. Estimates of the coefficients and significant levels are presented in Table 3. The chi-square goodness-of-fit test statistics of the model show that the model fits the data with significance at 1% level. This shows that the independent variables are relevant in explaining the farmers' decision to transfer the improved seed variety. T test of the parameter estimates indicates that the decision to transfer seed is mainly influenced by six variables.

The coefficient of the sociological variable (Fl) possesses the expected sign. The use of family labour (Fl) in farm production may likely influence farmer-to-farmer dissemination of improved cowpea variety positively. This observation was however not statistically significant. The coefficient of the variable measuring farmer status (St) was found to

Table 3: Parameter estimates of the logit model of the decision of a small-scale farmer to transfer improved cowpea seeds to other farmers

Variable	*Parameter Estimate*	*Standard Error*	*T values*
St	-0.2055	0.2829E-03	-0.727
Mr	-0.1189E-03	0.1908E-03	0.623
Fl	0.1917E-02	0.1048E-01	0.183
Mk	0.2152E-04	0.2516E-03	4.405*
Ar	0.1233E-02	0.8237E-04	4.902*
Yl	-0.2954E-03	0.1966E-03	-3.586**
Tp	-0.8216E-04	0.8066E-04	-1.242
Ct	0.6576E-04	0.6907E-04	1.334
Sr	0.2027E-03	0.9614E-04	1.669
Ap	-0.6805E-03	0.1966E-03	-3.462**
Tq	0.5495E-03	0.1581E-03	3.475**
Bq	0.2178E-03	0.1088E-03	2.002
INTERCEPT	0.8796	0.7325E-01	12.008*

Log likelihood function = -21.899; Chi squared = 96.19;
* Significant at 1%; ** Significant at 5%; n = 133

influence farmers' decisions negatively but not significantly. This indicates that, farmers with social status in the village are not likely to enhance farmer-to-farmer diffusion of improved cowpea seeds at the farm level. Similarly, the coefficient of the sociological variable Mr does not agree with *a priori* expectations. Even though the variable is not significant it indicates that farmers who belong to social organisations are not likely to share seeds amongst themselves. It is likely that they can share information on agricultural production issues but not necessarily disseminate seeds. Also it is possible that participating farmers belonging to the same or different organisations in the study area all had the improved breeder seeds with the introduction of the project.

The coefficient of total cowpea area cultivated (Ar) was positive and significant at 1% level. This implies that farmers with relatively larger cowpea farms will be more willing to transfer seed. Grisley (1994) obtained a similar result from a study among small-scale bean farmers in Uganda. In addition, farm size has been documented in various studies to be an important factor in technology adoption and dissemination (Feder *et al.*, 1985). This finding supports other studies and suggests that farm size can be an indicator of the farmers' decision to transfer new cowpea seed to other farmers. Total improved cowpea area harvested is therefore consistent with *a priori* expectations.

The coefficient for the economic variable representing seed market price, (Mk) is significant at 1% level and has the expected sign. The null hypothesis, that market price was irrelevant to the farmers' decision to transfer seed, is rejected. This implies that seed price is relevant and that farmers become more willing to transfer seed to others as they receive higher market prices for seed. A profitable market price is therefore likely to enhance farmer-to-farmer transfer of improved technologies at the village level.

The sign of the coefficient Yl behaved contrary to *a priori* expectations. The value of the variable indicates that the higher the yield obtained, the less the likelihood of farmers to transfer the improved variety to other farmers. The coefficient of this variable was found to be significant at 5%. Evidence (table 1) already suggests that farmers sell most of their output but higher yields do not necessarily mean that farmers will exceed their existing seed transferring capacity to other farmers. They are likely to maintain the same level of seed transfer due to greater productivity of the new improved seed variety. The signs of the coefficients for the other economic variables namely, Ct and Sr, were consistent with *a priori* expectations. The coefficient of the variable for small ruminants was significant at 10% probability level. This was not the case for the coefficient of the variable Ct. Hence the more livestock owned by a farmer, the more likely for him to transfer improved cowpea seeds to other farmers. Since farmers use livestock as a store of wealth, this observation suggests that wealthier farmers have a higher propensity to disseminate improved seed varieties. Use of complementary inputs like pesticide is postulated to discourage farmer-to-farmer dissemination of improved seeds. The coefficient of this variable agrees with *a priori* expectations and is found to be significant at 1%. Hence the extra expenditure required to purchase pesticides for production of improved cowpea may limit farmer-to-farmer dissemination of seeds at the farm level.

Farmers were asked to compare the threshing quality of the improved cowpea with that of local varieties in the study area. As expected, the coefficient of the variable (Tq) has the *a priori* positive sign and was found to be significant at 1%. Similarly, farmers' perception of the cooking quality (Bq) of the improved cowpea was consistent with *a priori* expectations even though it was not significant. Hence, farmers' perceptions about the threshing and cooking quality are important factors in explaining their willingness to transfer the improved cowpea variety to other farmers.

Individual farmer specific characteristics such as age, gender, and education variables that may affect the decision of a farmer to transfer seed were not included in the model. Gender was not included because all household heads were male. This is very typical in a mainly Moslem part of the country. Also, frequency of extension visit was not included because farmers participating in the seed production project had the same exposure to both extension and research staff involved in the project.

4 Summary and conclusion

The decision of farmers to transfer improved seed to others was influenced by the market prices of cowpea showing that market forces are important in explaining the rate of adoption of farm innovations. In order to enhance the production and dissemination of improved seed by small-scale farmers, production and distribution channels must remain profitable. Programs aimed at developing small-scale farmer seed production should ensure that cooperating farmers regard the project as a commercial enterprise, rather than a development project. Farmers' wealth status as indicated by number of livestock owned and area of land cultivated of the improved cowpea variety is important for farmer-to-farmer seed diffusion.

Farmers' perceptions on the post harvest qualities of the improved cowpea variety namely threshing quality and boiling quality are important in seed diffusion process. Thus, programs promoting farmer-to-farmer seed diffusion should ensure that crop varieties disseminated have acceptable post harvest technology attributes.

The informal approach to seed dissemination, can also complement formal seed exchange mechanisms, but would require to be strengthened for the rapid transfer of improved seed among farmers. For research institutions such as IITA that cooperate with farmers in various stages of improved seed development, a further step to increase impact is to develop mechanisms to strengthen the informal seed production and dissemination mechanisms. Such strategies could be developed in partnership with the existing institution, particularly farmers' organizations. Research or extension service providers could provide farmers' organizations with high quality seeds for multiplication and organize them into local seed producers and dealers. However, although, farmers may be the ideal partners in promoting diffusion of improved seeds, their circumstances (sociological, economic and perception factors) plays an important role in the supply of seed to other farmers.

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