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Technology characteristics, farmers' perceptions and adoption decisions: A Tobit model application in Sierra Leone

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ABSTRACT

The objective of this paper is to test the hypothesis that farmer perceptions of technology-specific characteristics significantly condition technology adoption decisions. Earlier adoption studies have not considered this in the analysis of the determinants of adoption decisions. The omission of farmers' evaluation of technology-specific attributes may bias the results of factors conditioning adoption choices.

A Tobit model was used to test this hypothesis using a stratified random sample of 124 mangrove swamp rice farmers in Sierra Leone. The issue investigated is the adoption of improved mangrove swamp rice varieties. The estimated model results show that farmer perceptions of the technology-specific attributes of the varieties are the major factors determining adoption and use intensities. Indicators of adoption determinants traditionally used in adoption-diffusion studies were found not to be important in driving adoption decisions. Therefore, there is need for adoption studies to consider farmers' perceptions of technology-specific attributes in the assessment of technology adoption decisions.

1. INTRODUCTION

Since the earlier classic work of Rogers (1962), efforts to explain the determinants of innovation diffusion and adoption continues. Two major

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groups of paradigms for explaining adoption decisions can be found in the literature: the innovation-diffusion, and the economic constraint paradigms.

The innovation-diffusion model, following from the work of Rogers, holds that access to information about an innovation is the key factor determining adoption decisions (for a good review see Argarwal, 1983). The appropriateness of the innovation is taken as given, and the problem of technology adoption is reduced to communicating information on the technology to the potential end users. By emphasizing the use of extension, media and local opinion leaders or by the use of experiment station visits and on-farm trials the 'skeptic' non-adopters can be shown that it is rational to adopt.

The economic constraint model (Aikens et al., 1975) contends that economic constraints reflected in asymmetrical distribution patterns of resource endowments are the major determinants of observed adoption behavior. Lack of access to capital (Havens and Flinn, 1976) or land (Yapa and Mayfield, 1978) could significantly constrain adoption decisions. While attempts have been made to assert the 'superiority' of the economic constraint model over the innovation-diffusion model (Hooks et al., 1983), such conclusions have been challenged (Nowak, 1987).

A third paradigm, which we shall call the 'adopter perception' paradigm (Kivlin and Fliegel, 1966a,b, 1967) – the least quantitatively developed in the literature – constitutes the focus of this paper. The concept, which is now being implicitly used in one form or the other in the agricultural economics literature (Gould et al., 1989; Norris and Batie, 1987; Lynne et al., 1988), suggests that the perceived attributes of innovations condition adoption behavior. The limited quantitative studies that have considered farmers' perceptions in the context of adoption decisions (e.g. Gould et al., 1989; Norris and Batie, 1987), have included a perception variable – measuring farmers' perception of a problem (e.g. soil erosion) – in their models. However, by being concerned primarily with only the farmers' perceptions regarding the severity of the problem to be solved, the studies implicitly take the technical innovations (designed to solve the problem) as appropriate for farmers.

Therefore, a gap exists in the adoption literature: How do farmers' perceptions of the technology-specific attributes themselves condition adoption decisions? Farmers have subjective preferences for technology characteristics (Ashby and Sperling, 1992; Ashby et al., 1989) and these could play major roles in technology adoption. Adoption (rejection) of technologies by farmers may reflect rational decision making based upon farmers' perceptions of the appropriateness (inappropriateness) of the characteristics of the technologies under investigation. By extending the analysis to cover the attributes of the technology that may condition adoption behavior, ex-post adoption studies could further increase their utility for directing appropriate technology development strategies.

Therefore, the objective of this paper is to test the hypothesis that farmer perceptions of technology-specific characteristics significantly explains technology adoption decisions. It is argued that the omission of such variables in adoption models may bias the results on the factors determining adoption decisions of farmers. The specific case examined in the paper is farmers' adoption decisions regarding modern mangrove swamp rice varieties in Sierra Leone. The rest of the paper is divided into five sections. Section 2 gives an overview of the adoption of modern mangrove swamp rice varieties in Sierra Leone. Section 3 discusses the conceptual model, while Section 4 presents the empirical model. Section 5 discusses the empirical results, and the paper ends in Section 6 with conclusions.

2. MODERN MANGROVE SWAMP RICE VARIETIES IN SIERRA LEONE

The mangrove rice ecology stretches about 1.2 million hectares in West Africa, out of which over 200 000 ha are currently under cultivation in Guinea-Bissau, Gambia, Guinea, Senegal, Sierra Leone, and Nigeria. Mangrove swamps are located on the tidal estuaries close to the ocean. They are difficult environments for growing rice, particularly during the dry season, when salts deposited by the tidal flows are not easily washed off the land. Rice growing is restricted to the rainy season when the rains flush salt from the soil. The rice growing period is directly related to the distance of the rice cultivating areas from the sea. The length of the salt-free period increases with increasing distance away from the sea. Three mangrove rice growing zones can be distinguished depending on the duration of the salt-free periods: (1) short season zone: with salt-free periods of less than 4 months; (2) medium growing season zone: with salt-free periods of 4–6 months; and (3) long growing season zone: with salt-free periods of more than 6 months.

Over 3000 mangrove rice varieties and lines (both local germplasm and crosses with introduced lines) have been screened and 17 high-yielding varieties have been recommended to farmers in West Africa (WARDA, 1989). A number of these modern mangrove rice varieties are high-yielding, fit the different salt-free growing periods, and show tolerance to some major pests and diseases such as blast, stem borers and crabs (WARDA, 1989). The modern mangrove swamp rice varieties that were investigated in this study (i.e. ROK 5, ROK 10, Kuatik Kundur and CP 4) were introduced into Sierra Leone through collaborative research between the Sierra Leone Rice Research Station and the West Africa Rice Development Association. ROK 5 is a short-duration variety (<4 months), Kuatik Kundur is a

TABLE 1

Descriptive data on the adoption of the modern mangrove swamp rice varieties in the Great Scarcies survey area in Sierra Leone

	Years				
	1986	1987	1988	1989	1990
Percentage of farmers adopting modern varieties					
	5	7	15	39	52
Percent of farmers adopting selected modern varieties					
ROK 5	4	5	6	14	20
ROK 10	0	1	5	15	16
Kuatik Kundur	1	1	4	10	16
Percent area cultivated in modern varieties					
	n.a.	n.a.	11	18	21

n.a., not available.

medium duration variety (4–6 months); ROK 10, ADNY-301 and CP-4 are long season varieties (> 6 months). The adoption patterns of the modern varieties (Table 1) show that in the Great Scarcies study zone, these varieties have met with extensive adoption among farmers. The percent of farmers adopting improved varieties increased from 5% in 1986 to 52% in 1990. ROK 5, ROK 10 and Kuatik Kundur had been adopted by 20%, 16% and 16% of farmers, respectively, in 1990. The area cultivated under improved varieties rose from 11% in 1988 to 21% in 1990.

3. CONCEPTUAL MODEL

Following Rahm and Huffman (1984), farmers' adoption decisions on the modern mangrove rice varieties are assumed to be based upon utility maximization. Define the varietal technologies by j, where $j = 1$ for the new technology and $j = 2$ for the old technology. The non-observable underlying utility function which ranks the preference of the ith farmer is given by $U(M_{ji}, A_{ji})$. Thus, the utility derivable from the varietal technology depends on M which is a vector of farm and farmer-specific attributes of the adopter and A which is a vector of the attributes associated with the technology. Although the utility function is unobserved, the relation between the utility derivable from a jth technology is postulated to be a function of the vector of observed farm, farmer specific characteristics (e.g., farm size, age, experience of farmer), and the technology specific characteristic (e.g., yield, taste, tillering capacity etc) and a disturbance term having a zero mean:

$$U_{ji} = \alpha_j \mathrm{F}_i(M_i, A_i) + e_{ji} \qquad j = 1, 2; i = 1, \ldots, n \tag{1}$$

Equation (1) does not restrict the function F to be linear. As the utilities U_{ji} are random, the ith farmer will select the alternative $j = 1$ if $U_{1i} > U_{2i}$ or if the non-observable (latent) random variable $y^* = U_{1i} - U_{2i} > 0$. The probability that Y_i equals one (i.e., that the farmer adopts an improved rice variety) is a function of the independent variables:

$$\begin{aligned} P_i &= \Pr(Y_i = 1) = \Pr(U_{1i} > U_{2i}) \\ &= \Pr[\alpha_1 F_i(M_i, A_i) + e_{1i} > \alpha_2 F_i(M_i, A_i) + e_{2i}] \\ &= \Pr[e_{1i} - e_{2i} > F_i(M_i, A_i)(\alpha_2 - \alpha_1)] \\ &= \Pr(\mu_i > -F_i(M_i, A_i)\beta) \\ &= F_i(X_i\beta) \end{aligned} \tag{2}$$

where X is the $n \times k$ matrix of the explanatory variables, and β is a $k \times 1$ vector of parameters to be estimated, $\Pr(\cdot)$ is a probability function, μ_i is an random error term, and $F(X_i\beta)$ is the cumulative distribution function for μ_i evaluated at $X_i\beta$. The probability that a farmer will adopt the modern mangrove rice variety is a function of the vector of explanatory variables and of the unknown parameters and error term. For all practical purposes, equation (2) cannot be estimated directly without knowing the form of F. It is the distribution of μ_i that determines the distribution of F. If μ_i is normal, F will have a cumulative normal distribution (Rahm and Huffman, 1984).

Following equation (2) the functional form of F is specified with a Tobit model, where μ_i is an independently, normally distributed error term with zero mean and constant variance σ^2:

$$\begin{aligned} Y_i &= X_i\beta \qquad \text{if} \quad i^* = X_i\beta + \mu_i > T \\ &= 0 \qquad\quad \text{if} \quad i^* = X_i\beta + \mu_i \leq T \end{aligned} \tag{3}$$

where Y_i is the probability of adopting (and the intensity of use of) the modern mangrove rice varieties; i^* is a non-observable latent variable, and T is a non-observed threshold level.

The Tobit model (Tobin, 1958) therefore measures not only the probability that a mangrove rice farmer will adopt the new variety but also the intensity of use of the technology once adopted. Thus, equation (3) is a simultaneous and stochastic decision model. If the non-observed latent variable i^* is greater than T, the observed qualitative variable y_i that indexes adoption becomes a continuous function of the explanatory variables, and 0 otherwise (i.e. no adoption). In cases where substantially large numbers of decision makers have completely adopted the technology, a variant of the one-limit Tobit model in equation (3) (i.e. a 2-limit Tobit proposed by Rossett and Nelson (1975)), could be used (e.g. Gould et al., 1989). Such an application of the Tobit analysis is, however, not appropriate for this study as only seven farmers (or 3% of the respondents) had completely adopted the improved rice varieties on all their total cropped area. The use of the one-limit Tobit model in this study is consistent with other earlier studies (Akinola and Young, 1985; Shakya and Flinn, 1985; Norris and Batie, 1987).

4. EMPIRICAL MODEL

The data on which the empirical model is based were collected in 1990–1991 during an intensive 6-month village level survey of a stratified random sample of 124 mangrove swamp rice farmers in the Great Scarcies area of Sierra Leone. The estimated empirical model, derived from equation (1) to equation (3), was developed using the farm and farmer specific attributes and farmer perception variables regarding technology specific characteristics of the modern varieties. The dependent variable is the proportion of the total varietal portfolio mix (i.e. local and improved varieties) that is constituted by improved varieties The definitions and measurements, and the sample characteristics of the variables are given in Table 2 and Table 3, respectively. Further details are available elsewhere (Zinnah, 1992).

The attribute vector A in equation (1) was specified in the empirical model to include the following variables: taste, yield, ease of cooking, tillering capacity and the ease of threshing the harvested rice. Taste is an important attribute desired by rice farmers, especially since rice is mainly home-consumed in the study zone. Surveys in other parts of West Africa have found that taste of rice was cited as an important trait desired by rice consumers (Adewusi et al., 1991). Ease of cooking of rice is directly linked to chemical characteristic of the rice grain (i.e. the gelatinization temperature). Varieties having high gelatinization temperatures take longer periods to cook (Unnevehr, 1986; Adewusi et al., 1991). Such a trait should be important to mangrove swamp rice farmers given that fuel-wood supply is severely limited along the mangrove swamps. Women and children in mangrove swamp rice cultivating households (especially those closer to the sea) often have to travel several kilometers by boats in search of fuel-wood in the upland zones. It is hypothesized that ease of cooking is positively related to adoption.

Ease of threshing is hypothesized to be positively related to adoption. The traditional methods of threshing rice are highly labor intensive and consist of either pounding the harvested paddy with sticks or with the sole of the feet. Therefore, varieties that are easier to thresh are more likely to be preferred by farmers. Tillering ability of rice is important to mangrove swamp farmers, as they link this with tolerance to crab damage, a major

TABLE 2

Definitions of variables in the empirical model

Dependent variable	
PROPOTN	The proportion of the total varietal portfolio (i.e. local and improved varieties) that is constituted by improved varieties.
Independent variables	
AGE	Age of the farmer, measured in years.
FARMSIZE	Farm size, measured in hectares.
EXTENSION	Contact with extension agents. Measured as a binary variable: 1 if the farmer has been in contact with any extension, 0 otherwise.
ONFARM	Participation in on-farm trials, measured as a binary variable: 1 if farmer had participated in on-farm trials, 0 otherwise.
EXPERIENCE	Years of experience in mangrove rice farming, measured in years.
TASTE	Taste. Measured as a binary variable: 1 if the farmer thought the improved variety was superior to local varieties in terms of taste, 0 otherwise.
YIELD	Yield. Measured as a binary variable: 1 if the farmer thought the improved variety was superior to local varieties in terms of yield.
COOK	Ease of cooking. Measured as a binary variable: 1 if the farmer thought the improved variety was superior to the local varieties in terms of time to cooking.
THRESH	Ease of threshing. Measured as a binary variable: 1 if the farmer thought the improved variety was superior to the local varieties in terms of ease of threshing, 0 otherwise.
TILLER	Tillering capacity. Measured as binary variable: 1 if the farmer judged the improved variety to be superior to the local varieties, 0 otherwise.

TABLE 3

Descriptive statistics on the variables used in the empirical model, Sierra Leone

Variable	Mean values	Standard deviation
PROPOTN	0.22	0.25
AGE	56.44	14.79
FARMSIZE	1.66	1.02
EXTENSION	0.26	1.65
ONFARM	0.16	0.35
EXPERIENCE	30.21	15.40
TASTE	0.35	0.47
YIELD	0.28	0.44
COOK	0.40	0.49
THRESH	0.32	0.46
TILLER	0.28	0.43

problem to young rice seedlings in mangrove rice ecologies (WARDA, 1989). Varieties with high tillering capacity still give good yields despite crab damage, especially due to the re-growth of new tillers. It is hypothesized that tillering capacity is positively related to probability of adoption.

The perceived superior yield performance of modern rice variety is expected to be related to adoption and use intensities. On-farm trials in the study zone show that the modern varieties have significantly out-performed local varieties under farmers' conditions (Adams, 1986). Therefore, it is hypothesized that the perceived yield superiority of the modern varieties is positively linked with adoption decisions.

The farm and farmer specific factors included in the model (i.e. vector M) are based on innovation diffusion theory and earlier studies. These include age of the farmer; farm size; participation in on-farm mangrove rice trials; contact with extension agents and the years of experience since the farmer became an owner of a mangrove rice farm. The latter is to be distinguished from general farming experience. General farming experience is not relevant for the empirical model since most farmers judge their total experience as starting from the first day that they started going out with their parents to the mangrove rice fields. What is important is the experience since the farmer became a decision maker on his own field (Mueller and Jansen, 1988).

Farm size has been shown to positively affect adoption decisions (Polson and Spencer, 1991; Akinola, 1987; Norris and Batie, 1987). Therefore, it is hypothesized that the sign on this variable in the empirical model is positive. Studies have shown that age of the farmer is related to adoption decisions. Younger farmers have been found to be more knowledgeable about new practices and may be more willing to bear risk due to their longer planning horizons (Bultena and Hoiberg, 1983; Gould et al., 1989; Polson and Spencer, 1991). Following earlier empirical findings, the maintained hypothesis is that age is negatively related to adoption.

Contact with extension agents is expected to have a positive effect on adoption based upon the innovation-diffusion theory. Such contacts, by exposing farmers to availability of information can be expected to stimulate adoption (Polson and Spencer, 1991; Voh, 1982; Osuntogun et al., 1986; Kebede et al., 1990). Years of experience in mangrove swamp rice farming is expected to be related to the ability of the farmer to obtain, process, and use information relevant to cultivation under this rice ecology. A positive relationship is hypothesized between this variable and the probability of adoption of modern swamp rice varieties. Participation in on-farm experimental trials on mangrove rice is an 'exposure variable' and is hypothesized to be positively related to adoption.

Three variations of the empirical model were estimated: (1) using only

TABLE 4

Estimated results for farmer adoption model using only farm and farmer specific variables, Sierra Leone

	Normalized coefficient	Asymptotic		Regression coefficient
		Standard error	T-ratio	
Independent variables				
AGE	−0.65850E−02	0.10115E−01	−0.65102	−0.27062E−02
FARMSIZE	0.13423	0.10007	1.3413	0.55166E−01
ONFARM	0.44500	0.26639	1.6705 *	0.18288
EXTENSION	0.10302	0.58208E−01	1.7698 *	0.42336E−01
EXPERIENCE	0.14197E−01	0.9954E−02	1.4262	0.58345E−02
INTERCEPT	−0.23197	0.44411	−0.52232	−0.95332E−01
Dependent variable				
PROPOTN	2.4333	0.24349		

The predicted probability of Y (i.e. PROPOTN) > limit given average $X(I) = 0.5585$.
The observed frequency of Y (i.e. (PROPOTN) > limit is 0.5161.
At mean values of all $X(I)$, $E(Y) = 0.1960$.
Log-likelihood function = −76.378235.
Mean-square error = 0.57961189E−01.
Mean error = −0.13732954E−01.
Squared correlation between observed and expected values = 0.66804E−01.
*, significant at 10%.

the farm and farmer specific factors; (2) using farmers' perceptions of the technology-specific factors; and (3) using the farm and farmer specific factors, and the farmer perceptions of the technology specific characteristics. An iterative maximum likelihood algorithm (White, 1978) was used to estimate the empirical models in order to obtain asymptotically efficient parameter estimates.

5. EMPIRICAL RESULTS

When only the farm and farmer specific characteristics are considered (model 1), none of these variables are significant at 0.05 significance level. However, at the 0.10 significance level, participation in on-farm tests and contacts with extension agents are significant in explaining adoption decisions. Apart from age, all the farm and farmer specific variables are positively related to adoption decisions (Table 4). When only the farmer perceptions of technology-specific characteristics are considered (model 2), all of the varietal specific traits, except taste, were highly significant (at the 0.01 and 0.05 significance levels) in explaining adoption and use intensities

TABLE 5

Estimated results for farmer adoption model using only technology-specific variables, Sierra Leone

	Normalized coefficient	Asymptotic		Regression coefficient
		Standard error	T-ratio	
Independent variables				
TASTE	0.77579E−01	0.33111	0.2343	0.20551E−01
YIELD	0.80335	0.26301	3.0544 **	0.21281
COOK	0.81273	0.35102	2.3153 *	0.21530
TILLER	0.82337	0.28761	2.8628 **	0.21812
THRESH	0.72282	0.26499	2.7277 **	0.19148
INTERCEPT	−0.79818	0.17493	−4.5629 **	−0.21145
Dependent variable				
PROPOTN	3.7749	0.36080		

The predicted probability of Y (i.e. PROPOTN) > limit given average $X(I) = 0.6016$.
The observed frequency of Y (i.e. (PROPOTN) > limit is 0.5161.
At mean values of all $X(I)$, $E(Y) = 0.1433$.
Log-likelihood function = −28.941072.
Mean-square error = 0.329456E−01.
Mean error = −0.13735456E−01.
Squared correlation between observed and expected values = 0.48985.
**, significant at 1%.
*, significant at 5%.

of the modern rice varieties. In conformity with the maintained hypotheses, all these varietal specific variables, including taste, are also positively related to the probability of adoption and the intensity of use of the modern mangrove rice varieties (Table 5). Combining both farm and farmer specific, and technology specific variables (model 3), the results show that none of the farm and farmer specific factors argued in the adoption literature was significant in explaining the adoption decisions of modern mangrove rice varieties. Rather, farmer perceptions of the technology-specific traits of these varieties have been the major factors conditioning adoption behavior (Table 6). These results, which are robust, strongly confirm the maintained hypotheses that farmers' perceptions of attributes of agricultural technologies determine observed adoption choices. Thus, past conclusions often reported in the adoption and diffusion literature about how farm and farmer specific factors significantly affect adoption of agricultural technologies were not supported by evidences from this study.

The empirical model can be used to draw economic implications for commodity improvement strategies for mangrove swamp rice in Sierra

TABLE 6

Estimated results for farmer adoption model using farm and farmer specific factors and technology-specific variables, Sierra Leone

	Normalized coefficient	Asymptotic		Regression coefficient
		Standard error	*T*-ratio	
Independent variable				
AGE	0.1059E−02	0.1126E−01	0.9412E−01	0.27436E−03
FARMSIZE	−0.9825E−01	0.1106	−0.8881	−0.25436E−01
ONFARM	0.6648E−01	0.2893	0.2297	0.17211E−01
EXTENSION	0.8369E−02	0.6016E−01	0.1390	0.21665E−02
EXPERIENCE	0.1051E−01	0.1089E−01	0.9651	0.27217E−02
TASTE	0.1206E−01	0.3406	0.3542	0.31240E−02
YIELD	0.7799	0.2739	2.8464 **	0.20190
COOK	0.9208	0.3616	2.5464 *	0.23838
TILLER	0.8913	0.2919	3.0533 **	0.23075
THRESH	0.6911	0.2672	2.5864 *	0.17891
INTERCEPT	−1.0311	0.5134	−2.0099 *	−0.26713
Dependent variable				
PROPOTN	3.8629	0.3696		

The predicted probability of Y (i.e. PROPOTN) > limit given average $X(I) = 0.6080$.
The observed frequency of Y (i.e. (PROPOTN) > limit is 0.5161.
At mean values of all $X(I)$, $E(Y) = 0.1426$.
Log-likelihood function = −27.538264.
Mean-square error = 0.31955121E−01.
Mean error = −0.1387888E−01.
Squared correlation between observed and expected values = 0.50519.
**, significant at 1%.
*, significant at 5%.

Leone. Following a Tobit decomposition framework suggested by McDonald and Moffitt (1980), the effects of changes of the varietal specific traits on adoption probabilities and use intensities can be obtained.

Let the expected value of the dependent variable PROPOTN across all observations be represented as $E(P)$, the expected value of the dependent variable conditional on the mangrove rice farmer being above the threshold limit (i.e. already an adopter and thus now concerned about use intensities) be given as $E(p)$, and the probability of the farmer being above the limit (i.e. the probability of adoption) be represented as $F(z)$, where $z = X\beta/\sigma$.

The relationship between these variables can be shown to be:

$$E(P) = F(z) * E(p) \tag{4}$$

For a given change in the level of the varietal specific attributes in the mangrove rice breeding program, the effects on farmer adoption behavior can be broken down into two parts by differentiating equation (4) with respect to the specific varietal attribute change:

$$\delta \mathrm{E}(P)/\delta X_i = \mathrm{F}(z)[\delta \mathrm{E}(p)/\delta X_i] + \mathrm{E}(p)[\delta \mathrm{F}(z)/\delta X_i] \tag{5.1}$$

Multiplying through by $X_i/\mathrm{E}(P)$, the relation in equation (5.1) can be converted into elasticity forms:

$$\begin{aligned}[\delta \mathrm{E}(P)/\delta X_i]X_i/\mathrm{E}(P) = \mathrm{F}(z)&[\delta \mathrm{E}(p)/\delta X_i]X_i/\mathrm{E}(P)\\ &+ \mathrm{E}(p)[\delta \mathrm{F}(z)/\delta X_i]X_i/\mathrm{E}(P)\end{aligned} \tag{5.2}$$

Re-arranging (5.2) by using equation (4):

$$\begin{aligned}[\delta \mathrm{E}(P)/\delta X_i]X_i/\mathrm{E}(P) = &[\delta \mathrm{E}(p)/\delta X_i]X_i/\mathrm{E}(p)\\ &+ [\delta \mathrm{F}(z)/\delta X_i]X_i/\mathrm{F}(z)\end{aligned} \tag{5.3}$$

Therefore, total elasticity of a change in the level of any of the varietal specific characteristics (which is assumed to be directly perceived by farmers) consists of two effects: (a) the change in the elasticity of the use intensities of the modern mangrove rice varieties, for those mangrove rice farmers that are already adopters; and (b) the change in the elasticity of the probability of being an adopter.

The computed elasticities, using model 3, are reported in Table 7. The estimates show that marginal changes in the perceived technology specific characteristics increases the probability of adoption of the rice varieties more than it increases the use intensities. However, the elasticity estimates show inelastic responses to changes in these characteristics. Cooking quality characteristic has the highest impact on the probability of adoption and use intensities. The total elasticity value is 0.86, which is divided into 0.45 for the elasticity of adoption probability and 0.41 for the elasticity of use

TABLE 7

Tobit total elasticity decompositions for changes in the technology-specific characteristics perceived by farmers, Sierra Leone

	Elasticity of	
	Adoption probability	Expected use intensity
TASTE	0.0051	0.0047
YIELD	0.2630	0.2441
COOK	0.4474	0.4153
TILLER	0.3048	0.2830
THRESH	0.2629	0.2440

intensity. This suggests that a 10% improvement in the ease of cooking characteristic is expected to result in about 9% increase in the adoption and use intensities of the improved rice varieties. The probability of adoption will increase by 5%, while the use intensities will increase by 4%. Improving the tillering capacity of modern varieties in breeding programs is estimated to increase the total elasticity by 0.58, which is decomposed into 0.30 for the elasticity of the probability of adoption and 0.28 for the elasticity of the expected use intensity. Improving the yield and the ease of threshing characteristics are estimated to have similar effects on the total adoption elasticities and its' components. In each case, the total elasticity of 0.50 consists of 0.26 due to the elasticity of adoption and 0.24 attributable to the elasticity of expected use intensities.

Breeding efforts targeted solely at improving taste of the modern varieties is estimated to have little or no effect on adoption elasticities. This result may indicate that farmers are well used to the taste of their existing local varieties and are more likely to judge the local varieties as better in terms of taste. Nonetheless, research programs may wish to treat taste improvement as an important component of overall breeding objectives, but with much limited emphasis compared to the aforementioned factors.

6. CONCLUSIONS

This paper showed that farmer perceptions of technology-specific characteristics significantly condition technology adoption decisions. The results showed that the omission of such variables in adoption models may bias the results of the factors determining adoption decisions of farmers.

The results strongly suggest that farmer perceptions of technology-specific characteristics should be considered in evaluating the determinants of adoption decisions on agricultural technologies. Such variables will enrich the set of factors conventionally used in adoption studies (Feder et al., 1985)

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