Farmers' Perceptions and Adoption of New Agricultural Technology: Analysis of Modern Mangrove Rice Varieties in Guinea Bissau

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Introduction

Several theoretical and empirical approaches to characterize factors influencing adoption decisions of farmers exist in the literature (15, 16). Most of the studies focus on socioeconomic characteristics of farmers as the key determinants of technology adoption decisions. These include, but are not limited to, access to credit (19), land (23), information (27), extension (28; 32) and farm size (5; 26). While such socioeconomic characteristics of farmers are important, the majority of past studies have ignored farmers' subjective assessments of the characteristics specific to the technologies themselves and their results. Therefore, may suffer from the risk of biassing the factors that affect farmers' adoption decisions (1). Adesina and Zinnah (1) showed that farmers' perceptions of characteristics of agricultural technologies strongly influence farmers' adoption behavior and suggested that such factors should be taken into account in adoption studies.

This "adopter perception" paradigm (21; 22) suggests that "the perceived attributes of innovations condition adoption behavior" (1, p. 298). Evidence from recent studies using this framework has supported this paradigm (1; 2). Other authors, while not using this paradigm explicitly, have found that farmers' subjective perception of risk distribution of incomes from new technologies affect the level of technology adoption (14). Farmers' perceptions of erosion have also been found to affect soil conservation behavior of farmers (12; 13; 26). Economists that have examined consumer behavioral decisions (20; 24) have accumulated considerable evidence showing that consumers' subjective assessments of product attributes are important in motivating product demand.

The limited number of empirical studies on this subject, as it concerns agricultural technology adoption, justifies further investigation to assess its general applicability for adoption studies in developing countries agricultural settings. To test the relevance of this paradigm, we examined the adoption of modern mangrove swamp rice varieties (MV's) in Guinea Bissau - a small West African country. The objective of this paper is to determine the factors that affect farmers' adoption of the MV's in the Cumbidja River Basin of Guinea Bissau. Following the earlier authors (1; 2), we assumed that farmers' subjective assessments of the characteristics of the mangrove rice MV's, compared to the local rice varieties, are important in influencing farmers' adoption decisions in

Guinea Bissau. However, besides these factors, we also examine the effects of other socioeconomic and institutional factors as determinants of adoption decisions.

The technologies considered in this paper are modern mangrove swamp rice varieties that were developed or diffused by the West Africa Rice Development Association. However, despite several years of international rice research investments little has been known about the extent of diffusion and adoption of these MV's. Recently, studies conducted in Sierra Leone and Guinea (1; 2; 3) have shown significant adoption and economic impacts of the modern varieties in these countries. However, no study has yet examined the adoption of these varieties in Guinea Bissau, the country that accounts for close to 50 % of the total mangrove swamp rice in West Africa. The provision of this information for Guinea Bissau would be a very important information to future studies that wish to assess the impacts or rates of returns to international agricultural research investments in mangrove rice in West Africa.

2. The setting

2.1 Survey zone

Guinea Bissau is the only Portuguese speaking country in West Africa. With a population of only 945,000 people and GNP per capita of $ 184, it is one of the smallest and poorest countries in Africa. Agriculture is the mainstay of the economy and rice is the principal food crop. The Cumbidja River Basin, located in Southern Guinea Bissau, is a major mangrove rice area of Guinea Bissau. Mangrove rice farming is the primary activity of farmers in this area. The area in mangrove rice is estimated at close to 6,000 ha, accounting for 47 % of the total rice production in the Tombali region where the Basin is located. The mangrove rice farming system is highly labor intensive. Land preparation activities may take up to 73 - 97 person-days per hectare, especially during the first year of opening new mangrove swamp fields. Farming techniques are traditional and rely almost exclusively on locally made hand tools such as "Kebindé" (a traditional hoe) used in tillage and land preparation activities. Mangrove rice is grown solely as monocrops as no other crops can grow in the mangrove swamp.

The population of the Cumbidja area is dominated by the Balanta ethnic group who represent 52 % of the population of Guinea Bissau. Other ethnic groups in the area are the Manjocas, Papel, Nalú and Sosos. It has been suggested (31) that the society is mainly subsistence-oriented. However, evidence from recent studies of the Balanta economy show evidence of social change as farmers are increasingly selling their produce to generate cash for meeting other family needs (i. e., clothing, social ceremonies etc.). Gomes (17) found that about 39 % of the rice produced by farm-households in his survey was destined for the market. This finding agrees with our survey results that indicated that 129 out of the 197 farm-households surveyed showed that they sold some of their produce in local or neighboring markets. Data on the adoption behavior of farmers were collected from a stratified random sample of 197 farmers located in thirteen villages in the Cumbidja river basin area. Fifty-four percent of the villages were inhabited by the Balanta and about 23 % are purely Nalú villages. The remaining 23 % of the villages were mixed villages, consisting mainly of both Balanta and Nalú. These proportions are close to the respective weights of the various ethnic groups in the Tombali region. The sample also captured villages and farm households at different levels of contact with formal extension services or researchers. About 46 % of the villages have had contact with extension services or had participated in mangrove rice seed multiplication or on-farm trials on the MV's, while the remaining 54 % have had no contact with these services.

2.2 Spatial and temporal issues in diffusion and adoption

Before the creation of agricultural research institutions in Guinea Bissau, farmers were cultivating their own local mangrove rice varieties. Some of these varieties emanated from the neighboring country of Guinea, suggesting a long history of farmers' self-experimentation, adaptation and transnational exchange of varieties found promising by farmers elsewhere. In the study of Zinnah et al. (34), which they reported in this *Journal*, it was found that farmers in Guinea obtained some mangrove swamp rice varieties from those in Sierra Leone. Thus, farmers have created their own system of varietal exchange and diffusion, parallel to the formal varietal release and diffusion channels. A number of these local varieties have good yields, with the average yields being 2.8 t/ha. However, most of the varieties have long cycles (i. e., between 4 - 6 months), a characteristic that has become increasingly risky due to the decline in rainfall over the last decade.

Starting in the late 1970's, researchers initiated field and on-farm experimentation of more shorter cycle improved mangrove rice varieties at the Caboxanque Rice Research Station. Early test results showed that the improved varieties had an advantage over the local varieties in term of yield and crop cycle (30). Early attempts to diffuse the modern varieties started in 1975 with the creation of DEPA (the department of rice research and production), which has recently been transformed into INIPA - the national institute for agricultural research). DEPA's trials in 1976 - 77 mentioned two MV's (i. e., ROK 5 and IR-2035-120-3) as among the best varieties, with ROK 5 giving average on-station yield of 5.6 t/ha and IR-2035-120-3 giving an average yield of 5.4 t/ha). Seven years later, in 1985, ROK 5 was formally released by DEPA for farmers through extension and other development projects operating in the region. Agronomists emphasized the superior advantage of this variety over existing local varieties in terms of salt tolerance, short to medium cycle and high yields. Further research at the Caboxanque station identified other promising varieties (e. g., WAR 1, WAR 81-2-1-1, RD 15, WAR 77-5-2-2, BG 380-2) several of which have impressive yields. On-farm trials of the same varieties by the PRO-Tombali project between 1989 - 1991, using Cablack (the best local variety) as the check, showed that all the MV's had superior yields on farmers' fields and management conditions (11).

We estimated a logistic regression, using the cumulative number of farmers that had adopted the MV's from 1983 to 1993, to determine the rate of adoption of the MV's. The fitted curve (Fig. 1) from the regression shows a rapid speed of adoption of the MV's. In 1983, only 13 % of the farmers used MV's. By 1988, more than 50 % of the farmers had adopted modern varieties. By 1993, adoption of the varieties had reached the 70 % level of farmers. Three varieties were the most popular with farmers. These are ROK 5 (cultivated by 56 % of farmers), RD 15 (grown by 39 % of farmers) and ROHYB 6 (cultivated by only 5 % of farmers). Farmers suggested to us that among the major reasons for adopting these varieties were their shorter crop cycle, high yields and ease of threshing.

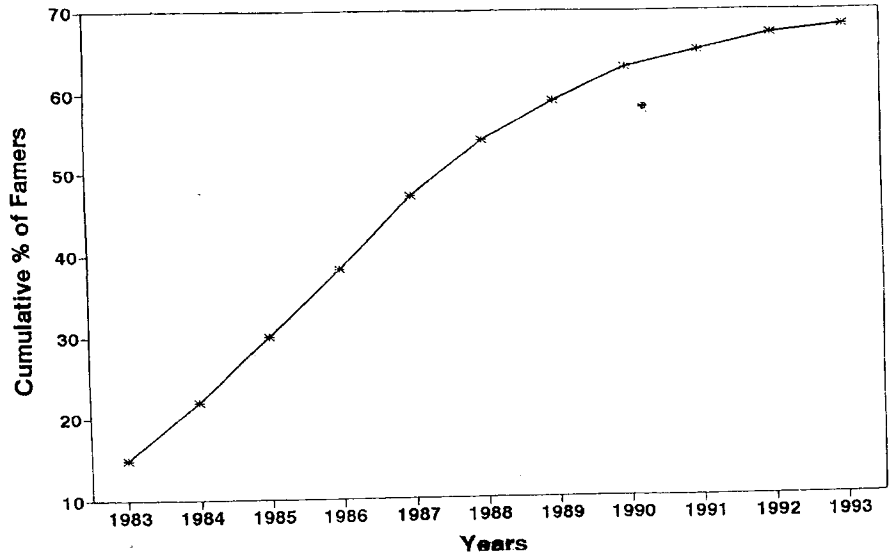

Figure 1: Adoption pattern in Cumbidja river G-B mangrove modern rice varieties

3. Methodology and empirical method

Farmers' adoption decisions of the modern mangrove rice varieties were modeled using the Logit model. Applications of such qualitative dependent variable models are not new in the adoption literature (4; 8; 23; 27). They have been shown to be the most appropriate methods for modeling of dichotomous decisions where one is interested in interpreting the qualitative dependend variable as a probability (6; 7). The Logit model is given as:

$$Q_{ik} = F(I_{ik}) = e^{Z_{ik}} / (1 + e^{Z_{ik}}) \quad (1)$$
$$\text{for } Z_{ik} = X_{ik}b_{ik} \text{ and } -\infty < Z_{ik} < à$$

where Q_{ik} is the dependent variable that takes on the value of 1 for adopters, and 0 otherwise. X_{ik} is a matrix of explanatory variables related to the adoption of MV's by farmer i, and b_{ik} are the vector of parameters to be estimated. I_{ik} is an implicit variable that indexes adoption. $F(I_{ik})$ is the probability that the ith farmer chooses to cultivated the MV's over a local variety, 0 otherwise. The logistic function is closely related to the standard normal cumulative function (7; 10). The statistical power of the estimated model was evaluated using the (a) percent of correct predictions of adopters and non-adopters, (b) Likelihood ratio test and (c) Cragg-Uhler R-Square measure.

The variables used in the specification of the empirical models are given in Table 1. The qualitative dependent variable (MVADOPT) takes on the value of 1 if the farmer adopted MV's and 0, otherwise. The farmer-specific socioeconomic explanatory variables are the age of the farmer (AGE), family size (FMSIZE), farm size (FARMS), contact with extension or rice development projects (CONTACT), years of experience in mangrove rice cultivation (EXP), education status (EDUC), commercialized farmer or subsistence orientation (COMMER), access to nonfarm income (NONFARM) and proportion of household members that are active in rice cultivation (ACTIV). Besides these, farmers' perceptions of the attributes of the MV's (in comparison with the local varieties) were used as explanatory variables. These include the assessments of the shortness of crop cycle (CYCLE), yield on farmers' fields (YIELD), the ease of threshing (THRESH), taste attribute (TASTE) and assessment of the starch content of the varieties (STARCH).

Age of farmers has been found to have indeterminate signs in various adoption studies (14). Younger farmers have been reported as having greater likelihood of adopting new technologies due to their longer planning horizons (9; 18). However, it may also be that with age farmers accumulate more personal capital and, thus, show a greater likelihood of investing in innovations. Older farmers may also be elders in the village and have preferential access to new information or technologies through extension services or development projects that work in the villages. Older farmers may have more skills in assessing new rice varieties in relation to the several local varieties that have existed in the village. It is hypothesized that AGE is positively related to adoption of the MV's. Farmers with large families may have a greater likelihood of adopting new technologies, especially within such labor intensive mangrove swamp farming systems. It is hypothesized that FMSIZE is positively related to the probability of adoption of MV's. A similar sign is hypothesized for the number of active workers in the household (ACTIV).

The effect of farm size (FARMS) on adoption is unclear in the adoption literature. For rice MV's in Bangladesh it was found by Allaudin and Tidsell (5) that while large farms were the early adopters of MV's, smaller farms adjusted quickly and adopted as fast as large farms. Thus, no significant differences were found for the effect of farm size.

Table 1: Descriptive statistics of the variables used in the Logit Model Analysis

	N	Mean	Standard Deviation	Variance	Min.	Max.
MVADOPT	197	0.69	0.46	0.21	0	1
AGE	197	47	13	1179	19	80
FMSIZE	197	10	6.9	50	2	55
FARMS	197	3.5	2.84	8.1	0.28	18
CONTACT	0.23	0.42	0.17	0.17	0	1
EXP	197	20	12	150	1	55
EDUC	197	0.65	0.48	0.22	0	1
COMMER	197	0.71	0.45	0.20	0	1
NONFARM	197	0.41	0.49	0.24	0	1
ACTIV	197	0.63	0.19	0.38	0.2	1
YIELD	197	0.23	0.42	0.17	0	1
THRESH	197	0.31	0.46	0.21	0	1
TASTE	197	0.32	0.46	0.22	0	1
STARCH	197	0.51	0.22	0.48	0	1
CYCLE	197	0.40	0.49	0.24	0	1

Exposure of farmers to new information and technologies occur through contact with extension agents or development projects working in the villages. The innovation-diffusion theory assumes that such contacts may stimulate adoption (28; 32). It is hypothesized that CONTACT is positively related to adoption of MV's. As farmers' accumulate experience it can be expected that this would positively influence their decision-making skills in rice cultivation. It has been argued that the number of years since farmers became actual decision makers on their own fields is the most relevant measure of experience (25). It is hypothesized that EXP is positively related to adoption. Farmers' education has been found to influence the adoption of soil conservation technologies (13; 26). Thus, EDUC is hypothesized to be positively related to adoption. Commercially oriented farmers would be expected to have higher likelihood of adopting new technologies, especially if such technologies give higher productivity. It is hypothesized that COMMER is positively related to adoption. Non-farm income (NONFARM) may also influence technology adoption. This is particularly so for lumpy technologies as animal traction (29) or for divisible technologies that require farmers' investment in complementary inputs (e. g., fertilizers, herbicides, insecticides use for input-responsive high yielding varieties). However, non-farm income may also be used to further diversify away from agriculture, especially in risky environments (29). Thus, the sign for NONFARM is an empirical question.

Farmers' assessments of the technology characteristics were measured by asking farmers to compare the MV's with the best local variety for each of the major characteristics. These responses were then scaled and used to define the variables used in the empirical model. For each characteristic, the relevant technology-related variable takes on a value of 1 if the farmer assesses the MV's as better than the local variety, and 0 otherwise. It is hypothesized that CYCLE is positively related to adoption. As previously mentioned, Guinea Bissau, which is similar to the situation in other Sahelian countries of West Africa, has been experiencing low and erratic rains over the last two decades. Longer cycle traditional varieties are being replaced by shorter cycle varieties as farmers seek to reduce their production risks. In our survey we found that preference for short cycle varieties ranked second after yield in the varietal preferences of farmers. Thirty-four percent of the farmers ranked short-cycle as a priority in choosing varieties. It is hypothesized that YIELD is positively related to adoption. On-farm tests have shown that the MV's consistently outperform the local varieties in both station and on-farm tests in the Tombali region. Over 70 % of farmers in our survey said that yield was the most important criterion when deciding the choice of varietal technologies. It is hypothesized the THRESH is positively associated with adoption of the MV's. It has been found in a study in Sierra Leone (1) that this trait is significant in influencing farmers' adoption of mangrove rice MV's. Varieties that are easier to thresh are appreciated by farmers because of the high labor requirements of manual threshing operations. Difficulty of threshing is one of the major reasons that farmers do not appreciate some local varieties (e. g., N'Conto, Some) despite their modest yields. The taste of rice varieties (TASTE) would be expected to be important in farmers' adoption of decisions. However, as found be Adesina and Zinnah (1) in Sierra Leone, it is difficult for MV's to surpass the local varieties in terms of taste. Finally, it is expected that STARCH is positively related to adoption. Varieties with high starch contents "stay longer in the stomach" according to farmers.

4. Empirical results

The estimated model (Table 2) has good explanatory power as judged by the percent number (i. e., 78 %) of correct predictions of adopters and non-adopters. Ten out of the fourteen variables in the model have the expected signs, with four being significant at between the 5 % and 1 % level. Contact with extension or development project agents (CONTACT) was significant at the 1 % level. This result sharply contrasts with results in Sierra Leone where Adesina and Zinnah (1) found that extension had no significant effect on adoption. It has been noted that farmers' contact with extension was extremely low in Sierra Leone and that the mangrove MV's were diffused via farmer-to-farmer exchanges (34). In Guinea Bissau, this was not so. The active on-farm testing programs of the now defunct Department of Rice Research and Production were highly instrumental in providing farmers with access to the MV's. These previous efforts of the Department have paid off in terms of farmers' adoption of the MV's. Among the varietal-specific attributes of the MV's, those that are statistically significant in influencing farmers' adoption are YIELD, THRESH, and

CYCLE. These are significant at the 5 %, and 1 % levels, respectively. It is interesting to note that commercialization of rice (COMMER) is positively related to adoption, but significant only at between the 10 % - 15 % level. These results support the earlier findings of previous authors that have examined adoption behavior of farmers using the "farmer perception paradigm" (1; 2) and further demonstrates that farmers' preferences for characteristics of MV's are important in deciding on adoption decisions.

Table 2: Estimated logit model results for the factors affecting farmers' adoption decisions on the improved mangrove rice varieties in the Cumbidja River Basin, Guinea Bissau

	Estimated Coefficient	Standard Error	Asymptotic T-ratio
Farmer Characteristics			
AGE	0.022	0.025	0.89
FMSIZE	0.031	0.030	1.03
FARMS	-0.051	0.064	-0.77
CONTACT	1.500	0.529	2.83 ***
EXP	-0.012	0.028	-0.44
EDUC	0.094	0.396	0.23
COMMER	0.543	0.437	1.24
NONFARM	-0.526	0.392	-1.34 *
ACTIV	0.388	0.892	0.43
Technology Characteristics			
YIELD	0.945	0.533	1.77 **
THRESH	1.157	0.443	2.60 ***
TASTE	-0.266	0.446	-0.59
STARCH	-0.344	0.936	-0.03
CYCLE	1.097	0.414	2.64 ***
Intercept	-1.64	1.211	-1.36 *

*** = significant at the 1 % level
** = significant at the 5 % level
* = significant at the 10 % level (2 tail-test)
Log-likelihood (0) = -121.09
Log-likelihood Function = -100.07
Likelihood Ratio Test = 42.05 with 14 D. F
Cragg-Uhler R-square = 0.27
Chow R-square = 0.23
Percentage of Correct Predictions = 78 %

4.1 Forecasting technology adoption patterns under social change

It is not uncommon in most crop improvement programs to focus mainly on yield enhancement. However, farmers are interested not only in yield but in other agronomic or food quality characteristics of varietal technologies. To guide future technology improvement research for mangrove rice in West Africa, we determined how focussing technology improvement on sole versus multiple traits of the MV's may affect future adoption patterns. A limitation of the earlier works (1; 2) is that, while they identified the importance of farmers' perceptions of varietal traits in influencing adoption decisions, they did not distinguish: (a) the relative importance of sole-trait versus multiple-traits' improvement on predicted adoption probabilities; and (b) how the relative importance of various technology attributes differentially affect the adoption decisions of farmers with different objectives: subsistence-oriented and commercially-oriented. Clearly, farmers' objectives would affect their relative preferences for various characteristics of varietal technologies. Consideration of these elements is essential for guiding crop improvement strategies. As aforementioned, the farming society of the Cumbidja River Basin is undergoing a process of social change with increased market penetration into the traditionally subsistence-oriented farming community. It is important for technological forecasting, to consider how this evolution of farmers' objectives may likely affect probability of adopting MV's in the future.

To assess the effects of various combinations of farmers' assessments of the characteristics of the MV's on the predicted probability of adoption, we used the logistic cumulative density function to generate the conditional adoption probabilities (6). Eight alternative technology attribute combinations were examined. The analysis distinguished two objectives of mangrove rice farming: (a) subsistence-orientation; and (b) commercial-orientation. These scenarios were considered for two distinct group of farmers: (1) farmers that have had contacts with extension or development project agents and (2) farmers that have not had such contacts.

The results show that when farmers assess their local varieties as better than the MV's in terms of yield, cycle and ease of threshing, the forecasted probability of adoption the MV's is extremely low. This ranges from 0.1 to 0.15 for Group 2 farmers in (a) and (b), respectively. For Group 1 farmers in (a) and (b), the predicted adoption probability ranges from 0.32 to 0.45, respectively. When only the yield of the MV's is considered better than the local varieties, the forecasted probability of adoption is highest for farmers with commercial orientation, especially those who have had contact with extension or development projects. For group one farmers, the forecasted adoption probability of the MV's range from 0.55 (for subsistence-oriented farmers) to 0.68 (for market-oriented farmers). For Group 1 farmers, their forecasted technology adoption probabilities are much lower, ranging from 0.22 (for subsistence oriented farmers) to 0.32 (for market-oriented farmers).

Across all the farmer groups, when MV's are considered as better than the local varieties for two technology attributes, the forecasted technology adoption probability

increases sharply. When the MV's are judged by farmers to be better than the local varieties for three traits simultaneously, the predicted probability that farmers will adopt the MV's is highest. This ranges from 0.72 to 0.82 for Group 1 farmers under (a) and (b), respectively. For Group 2 farmers, the forecasted probability of adoption range from 0.90 to 0.92. This suggests that to significantly improve the probability of adopting MV's, it will be important for crop improvement research to focus on simultaneously improvement of yield, crop cycle and ease of threshing attributes of future modern mangrove rice varieties. Also, these estimates suggest that the likelihood of farmers in this area adopting MV's in the future will significantly improve with market penetration and shift in production objectives from subsistence-orientation to market-orientation.

Table 3: Effects of farmers' assessments of technology characteristics on predicted probability of adoption of modern mangrove rice varieties (MV's): subsistence-oriented and commercial-oriented farmers, Cumbidja River Basin, Guinea Bissau

	Subsistence-Oriented	Commercially-Oriented
A: Farmers who have no contact with extension and rice development projects		
1. Local variety better than MV's for all characteristics	0.09	0.15
2. YIELD alone (MV's better)	0.22	0.32
3. THRESH alone (MV's better)	0.25	0.37
4. CYCLE alone (MV's better)	0.24	0.35
5. YIELD + THRESH (MV's better)	0.47	0.60
6. YIELD + CYCLE (MV's better)	0.45	0.59
7. THRESH + CYCLE (MV's better)	0.51	0.64
8. YIELD + THRESH + CYCLE (MV's better)	0.72	0.82
B: Farmers who have contact with extension and rice development projects		
1. Local variety better than MV's for all characteristics	0.32	0.45
2. YIELD alone (MV's better)	0.55	0.68
3. THRESH alone (MV's better)	0.60	0.72
4. CYCLE alone (MV's better)	0.59	0.71
5. YIELD + THRESH (MV's better)	0.79	0.87
6. YIELD + CYCLE (MV's better)	0.79	0.87
7. THRESH + CYCLE (MV's better)	0.82	0.89
8. YIELD + THRESH + CYCLE (MV's better)	0.92	0.95

5. Conclusions and implications

International rice research investment for mangrove rice in West Africa is having significant impacts on farmers' fields. Our results show that in Guinea Bissau, about 70 % of farmers in the Cumbidja River Basin - the major mangrove rice growing area of the country - have adopted modern mangrove rice varieties. These results agree with evidence of similar impacts of these modern rice varieties in Guinea and Sierra Leone recently reported in the literature (1; 2; 34). The results show that although contact with extension or rice development projects has positively influenced farmers' adoption, farmers' assessment of the superiority of these MV's to local varieties (for some key technology characteristics) has been the major driving force behind MV's adoption. Simultaneous improvements of these multiple traits would play an important role in shaping future adoption of other mangrove rice MV's. Also, as social change processes occur with increased market penetration into the rural areas, mangrove farmers' objectives in Guinea Bissau will shift from subsistence-orientation to market-orientation, and we forecast that the likelihood of farmers' adopting MV's will rise significantly.

Farmers are the eventual users of agricultural technology. They critically assess the characteristics of new technologies against those of existing local technologies and only adopt the former if they are judged superior to the latter for some critical attributes. Our work lends support for the need for adoption studies to diversity the portfolio of variables used in modeling adoption decisions (15; 16) to also include farmers' subjective assessments of technology characteristics. Omission of such variables in studies of agricultural technology adoption may bias the results of factors that influence farmers' adoption decisions.

Summary

This paper examines the diffusion and adoption of improved mangrove swamp rice varieties (MV's) in Guinea Bissau, using evidence from the Cumbidja River Basin, a major mangrove rice growing area of the country. The results of the study show that the adoption of MV's has been rapid and impressive in the Cumbidja zone. Diffusion of the MV's which started in 1983 with 13 % of farmers, had reached 70 % of farmers by 1993. A Logit model was used to quantify the factors that determine the observed adoption patterns. While contact with extension or rice development projects has positively influenced farmers' adoption, it is farmers' assessments of the superiority of these MV's to local varieties (for some key technology attributes) that has principally motivated farmers' adoption of the MV's. Model predictions of adoption probabilities show that it is very likely that simultaneous improvements of these multiple traits would play an important role in significantly increasing the likelihood of farmers' adoption of other MV's in the future. Also, as social change processes occur with increased market penetration into the rural areas, mangrove farmers' objectives in Guinea Bissau will shift from subsistence-orientation to market-orientation, and we forecast that the likelihood of farmers' adopting MV's will rise significantly. The study provides empirical evidence to support the need for future adoption studies to include farmers' assessments of technology characteristics in their models. Omitting such variables may bias the results of the factors that motivate farmers' adoption decisions.

Zusammenfassung

Die vorliegende Studie untersucht die Akzeptanz und Übernahme moderner Mangroven-Sumpfreissorten bei Landwirten in Guinea Bissau, im Cumbidja Flußtal, eines der Hauptanbaugebiete des Landes für Mangroven-Sumpfreis. Die Ergebnisse der vorliegenden Studie zeigen eine rasche und weitverbreitete Übernahme der verbesserten Sorten bei den Landwirten. Seit der Einführung der neuen Sorten im Jahre 1983, ist deren Übernahme bei Bauern von 13 % im selben Jahr auf 70 % im Jahre 1993 angestiegen. Ein Logit Modell wurde verwendet, um die Parameter zu quantifizieren, die das vorliegende Akzeptanzmuster bestimmen. Ausschlaggebend für die Motivation der Bauern moderne Reissorten anzubauen, war die eigene Erkenntnis der Bauern, daß sie mit den neuen Sorten höhere Kornerträge erzielten als mit ihren lokal angebauten Sorten. Ferner läßt sich die Übernahmerate für zukünftige moderne Sorten erhöhen, wenn andere aufgeführte Eigenschaften, die bei der Akzeptanz eine Rolle spielen, sich besser an die tatsächlichen Bedürfnisse der Landwirte in Guinea Bissau orientieren. Mit dem verbesserten Zugang der ländlichen Gebiete zum Absatzmarkt wird sich die Subsistenzbewirtschaftung in eine marktorientierte Landbewirtschaftung wandeln. Wir gehen davon aus, daß dies eine weitere Steigerung in der Übernahme von modernen Reissorten mit sich bringt. Die vorliegende Studie liefert den empirischen Beweis, daß auch die vom Landwirt abgegebene Beurteilung über Technologieeigenschaften in die Modelle zukünftiger Technologie-Übernahme-Studien einfließen sollte.

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References

1. *Adesina, A. A., and M. M. Zinnah:* Technology Characteristics, Farmers' Perceptions and Adoption Decisions: A Tobit Model Analysis in Sierra Leone. Agricultural Economics, 9: 297 - 311, 1993.

2. *Adesina, A. A., and J. Baidu-Forson:* Farmers' Perceptions and Adoption of New Agricultural Technology: Evidence from Tobit Analysis in Burkina Faso and Guinea, West Africa. Agricultural Economics, Vol (12): forthcoming, 1995.

3. *Adesina, A. A., and M. M. Zinnah:* Impact of Modern Mangrove Swamp Rice Varieties in Sierra Leone and Guinea. International Rice Research Notes, 18 (4): 4.

4. *Akinola, A. A.:* An Application of the Probit Analysis to the Adoption of the Tractor Hiring Service Scheme in Nigeria. Oxford Agrarian Studies, 16: 70 - 82, 1987.

5. *Allauddin, M., and C. A. Tisdell:* Dynamics of Adoption and Diffusion of HYV Technology: New Evidence of Inter-Farm Differences in Bangladesh, Occasional Paper No. 155, Department of Economics, The University of New Castle, N. W. S., Australia, 1988.

6. *Aldrich, J. H., and F. D. Nelson:* Linear Probability, Logit, and Probit Models. London: Sage Publications, 1984.

7. *Ameniya, T.:* Qualitative Response Models: A Survey. Journal of Economic Literature, 19: 1438 - 536, 1981.

8. *Bagi, F. S.:* A Logit Model of Farmers' Decisions about Credit. Southern Journal of Agricultural Economics, 15: 13 - 19, 1983.

9. *Bultena, G. L., and E. O. Hoiberg:* Factors Affecting Farmers' Adoption of Conservation Tillage. Journal of Soil and Water Conservation, 38: 281 - 284, 1983.

10. *Capps, O., and R. Kramer:* Analysis of Food Stamp Participation using Qualitative Choice Models. American Journal of Agricultural Economics, 67: 49 - 59, 1985.

11. *DEPA/PPC:* Rapport d'Activités de l'année, Guinea Bissau, 1991.

12. *Earle, T. R., Rose, C. W., and A. A. Brownlea:* Socioeconomic Predictors of Intention Towards Soil Conservation and Their Implication in Environmental Management, Journal of Environmental Management 9: 225 - 236, 1979.

13. *Ervin, C. A., and D. E. Ervin:* Factors Affecting the Use of Soil Conservation Practices: Hypotheses, Evidence and Policy Implications. Land Economics, 58: 277 - 292, 1982.

14. *Feder, G., and R. Slade:* The Role of Public Policy in the Diffusion of Improved Technology. American Journal of Agricultural Economics, 67: 423 - 428, 1985.

15. *Feder, G., Just, R. E., and D. Zilberman:* Adoption of agricultural innovations in developing countries: A survey. Economic Development and Cultural Change, 33: 255 - 297, 1985.

16. *Feder, G., and D. L. Umali:* The Adoption of Agricultural Innovations. A Review. Technological Forecasting and Social Change, 43: 215 - 239, 1993.

17. *Gomes, S.:* Economia Familiar Balanta na Orizicultura da Bolanha Salgada. VIENTA, DEPA, Guinea Bissau, 1989.

18. *Gould, B. W., Saupe, W. E., and R. M. Klemme:* Conservation Tillage: The Role of Farm and Operator Characteristics and the Perception of Erosion. Land Economics, 65: 167 - 182, 1989.

19. *Havins, A. E., and W. L. Flinn:* Green revolution technology and community development: the limit of action programs. Economic Development and Cultural Change, 23: 469 - 481, 1976.

20. *Jones, A. M.:* A Double-Hurdle Model of Cigarette Consumption. Journal of Applied Econometrics, 4: 23 - 29, 1989.

21. *Kivlin, J. E., and F. C. Fliegel:* Farmers' Perceptions of Farm Practice Attributes. Rural Sociology, 31: 197 - 206, 1966a.

22. *Kivlin, J. E., and F. C. Fliegel:* Attributes of Innovations as Factors in Diffusion. American Journal of Sociology, 72: 235 - 248, 1966 b.

23. *Lee, L. K., and W. H. Stewart:* Land Ownership and the Adoption of Minimum Tillage. American Journal of Agricultural Economics, 65: 256 - 64, 1983.

24. *Lin, C. T. J., and J. W. Milon:* Attribute and Safety Perceptions in a Double-Hurdle Model of Shellfish Consumption. American Journal of Agricultural Economics, 75: 724 - 729, 1993.

25. *Mueller, R. A. E., and H. G. P. Jansen:* Farmer and Farm Concepts in Measuring Adoption Lags. Journal of Agricultural Economics, 39: 121 - 124, 1988.

26. *Norris, P. E., and S. S. Batie:* Virginia Farmers' Soil Conservation Decisions: An Application of Tobit Analysis. Southern Journal of Agricultural Economics, 19: 79 - 89, 1987.

27. *Osuntogun, A., Adeyemo, R., and E. Anyanwu:* The Adoption of Innovation by Cooperative Farmers in Nigeria. Tropical Agriculture (Trinidad), 63: 158 - 160, 1986.

28. *Polson, R., and D. S. C. Spencer:* The Technology Adoption Process in Subsistence Agriculture: The Case of Cassava in South-Western Nigeria. Agricultural Systems, 36: 65 - 77, 1991.

29. *Savadogo, K., Reardon, T., and K. Pietola:* Determinants of Farm Productivity and Supply Response in Burkina Faso. Staff Paper No. 94-79. Department of Agricultural Economics, Michigan State University. East Lansing, Michigan, 1994.

30. *Schwarz, C.:* Balanco de dois anos de ensaios varietais (1976 - 77). DEPA, Guinea Bissau, 1978.

31. *Thomas, L.:* Reflexions sur Quelques Facteurs Socio-Economique a Prendre en Compte dans la Problematique d'Augmentation de la Production Rizicole en Guiné-Bissau. EDI-IRFED, Paris, 1987.

32. *Voh, J. P.:* A Study of Factors Associated with the Adoption of Recommended Farm Practices in a Nigerian Village. Agricultural Administration, 9: 17 - 29, 1982.

33. *Yapa, L. S., and R. C. Mayfield:* Non-Adoption of Agricultural Innovations: Evidence from Discriminant Analysis. Economic Geography, 54: 145 - 156, 1978.

34. *Zinnah, M. M., Comptom, J. L., and Adesina, A. A.:* Research-Extension-Farmer Linkages within the Context of the Generation, Transfer and Adoption of Improved Mangrove Swamp Rice Technology in West Africa. Quarterly Journal of International Agriculture, 32 (2): 201 - 241, 1993.