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THE STATUS OF THE ADOPTION OF MANGROVE SWAMP RICE VARIETIES IN SIERRA LEONE

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Abstract

Mangrove swamp rice varieties developed at the Rokupr Agricultural Research Centre (RARC), Sierra Leone were evaluated in 2014 to determine their adoption status in Kambia, Port Loko and Moyamba districts of Sierra Leone. The study evaluated farmers' knowledge about the varieties, the varieties grown by farmers at least once, adopters, non-adopters, loss of varieties, abandonment of varieties, and the determinants of the adoption of mangrove rice varieties. Data were obtained from a sample survey of 600 mangrove rice farmers using the multistage stratified random sampling technique. Farmers in the Kambia district were more knowledgeable about the mangrove varieties: ROK 5 and ROK 10 are the most adopted varieties while ROK 5, ROK 10 and CP 4 are the most cultivated and have been grown at least once by some farmers in all the districts – ROK 5 (380 farmers); ROK 10 (315 farmers); and CP 4 (99 farmers). Probit regression estimation shows that farmers' adoption of the mangrove rice varieties was affected positively and significantly by farmers' level of education, training, access to credit, farm size, contact with extension, and farming experience.

1. INTRODUCTION

The mangrove ecology has significant potentials for rice production in West Africa. Mangrove swamp rice farming is among the oldest rice farming systems in West Africa and accounts for 10% of the total regional rice production. The average mangrove rice farmers' annual yield is 2 t/ha of paddy compared to 1 t/ha for most other rice ecologies in the region (Agyen-Sampong, 1984).

This suggests that improving rice production in the mangrove ecology can enhance the production of enough rice to meet the increasing demand in West Africa in general and Sierra Leone in particular.

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Such improvement can be facilitated through technologies generated at research centers, disseminated and validated at the farm level and communicated to influence adoption by farmers. Adoption is most often a self-decision process based on the perceived knowledge and appreciation of the said technology in terms of its specific physical characteristics and intrinsic qualities. In addition to these factors, the related cost of the technology, its simplicity, adaptability to the farming circumstances, and its comparative advantage over existing local technologies constitute a range of potential factors that can affect adoption decisions made by farmers.

This study was undertaken to obtain an inventory of the disseminated and adopted mangrove swamp rice varieties in Sierra Leone.

1.1. Objectives of the study

The key objective was to evaluate the disseminated mangrove swamp rice technologies (mostly rice varieties) in the various rice growing ecologies and assess their adoption status in Sierra Leone. The specific objectives were to:

- List the mangrove swamp rice technologies and their present adoption status.
- Identify the key determinants of adoption of the improved mangrove swamp rice technologies.
- Identify key policy issues that will guide the strategy for out-scaling the improved mangrove swamp rice technologies to ensure high rates of their adoption.

2. METHODOLOGY

2.1. Sampling design

A multi-stage stratified random sampling procedure was adopted for the study. First, Kambia, Port Loko and Moyamba districts were purposively selected based on the ecology to be surveyed. The mangrove ecology is not spread across the country but is predominant in the selected districts. Then, two chiefdoms[1] were purposively selected from each district, based on the spread of the mangrove ecology therein. Finally, 100 farmers were randomly selected and interviewed per chiefdom. Thus 600 respondents were interviewed for the entire survey.

2.2. Data collection and analysis

Primary data were collected from selected samples of rice farmers within the various chiefdoms. For that purpose, a data collection tool was developed, field tested, and administered to farmers. Qualitative and quantitative methods were used to analyze the data with Microsoft Excel 10 and STATA 13, a robust analytical tool for socio-economic studies.

2.3. Probit regression model

Probit regression, also called probit model, is used to model dichotomous or binary outcome variables.

Data gathered in the 2014 cropping season on the cultivation of mangrove swamp rice varieties developed at the Rokupr Agricultural Research Centre (RARC) were used to define two categories of rice farmers:

- Adopter - a farmer who has planted a RARC variety at least once and continues to use such a variety in his/her field in the 2014 cropping season (the period when the survey took place), and
- Non-adopter - a farmer who previously planted a RARC variety but did not continue growing such a variety during the 2014 season.

[1] The third geographical division of Sierra Leone

Probit model is one of the most popular statistical methods developed for analyzing dichotomous response-dependent variables (Donkoh & Awuni, 2011). Most of the adoption literature estimate a probit model to ascertain the factors that affect the adoption of a new technology or innovation (Feder *et al.*, 1985). For instance, Foltz (2003) provided a theoretical explanation of the probit model and also summarized the factors that explain the rate of adoption/diffusion of a soil and water conservation technology under four hypotheses, viz resource scarcity, capital constraint, learning costs and risk aversion. According to Foltz (2003), increasing scarcity of a natural-resource endowment (like fertile lowland) leads to higher shadow prices for the resource, causing farmers to switch to a resource-conserving technology (like soil and water conservation technology). The capital constraint hypothesis implies that new technologies would spread faster among farmers with better access to capital to pay for the new technology than farmers with little or no access. Moreover, the learning-cost-hypothesis suggests that technologies will spread fastest in areas where information about the innovation is readily available and most easily evaluated by potential adopters. This means that farmers who have access to extension services, better education (able to read and understand information about the technology), the opportunity to attend useful workshops and participate in on-farm experimentation stand a better chance of adopting the technology than the less privileged ones. Lastly, risk aversion implies that farmers would not like to invest in unknown technologies because of uncertainties with regards yield and income.

Similarly, an expensive technology is relatively more risky because farmers are not sure if they would be able to recoup the money invested into the technology. In this case, the chances of adoption/diffusion would be slim. But, if a new technology is risk-reducing in the sense that farmers are familiar with it or it is relatively cheap, then farmers would readily adopt it, other things being equal.

The probit model was used in this study to empirically quantify the relative influence of various factors in the decision of the respondents to adopt the mangrove rice varieties developed by RARC.

From previous adoption studies, many factors influence farmers' adoption decision. For instance, Tiamiyu *et al.* (2009) found that age, education, land tenure status, farming experience, farm income, farm family size, family labour, contact with extension agents, membership of an association, credit use, and extent of commercialization influence farmers' adoption decisions. In India, Sita and Ponnarasi (2009) analysed variables like age, literacy level, farm size, income of households, number of earners in the family, and number of contacts with extension agencies as determinants of adoption. In the current study, it is postulated that the probability of a farmer adopting the RARC mangrove varieties (Pi) depends on farm and farmers' specific attributes like age, education, farmer's income, training, access to credit, membership of an association, farm size, sex, extension contact and farming experience. The index variable (Pi), which indicates whether a farmer adopts the RARC mangrove varieties, is a function of the independent variables (Xi).

In this study, age was measured in years, a dummy variable was used for education - a literate farmer was assigned a score of 1 and an illiterate farmer a score of 0. Farmers' income was determined based on farm income in the previous year. Training was determined based on rice farming training acquired and a dummy variable was used - farmers who acquired training were assigned a score of 1 and a score of 0 otherwise. Access to credit was measured as a dummy - farmers with access to credit were assigned a score of 1 and a score of 0 otherwise. A dummy variable was used for membership of an association - farmers who are members of an association were assigned a score of 1 and a score of 0 otherwise. Farm size (hectare) was defined as the size of the farm allocated to rice cultivation during the growing season under survey. A dummy variable was used to specify the sex of the respondent - a male respondent was assigned a score of

1 and a female respondent a score of 0. Extension services to the farmers were defined as a dummy variable in the model - 1 for farmers who received at least one contact with the extension service and 0 otherwise. Farming experience was incorporated into the model as the number of years for which the farmer has been a rice farmer.

Assuming that a farmer is an adopter of the RARC varieties, the probit regression model has been specified as follows:

$$Pi = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10})$$
$$Pi = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \mathcal{E}i$$

Where:
X_1 = age of respondent
X_2 = education
X_3 = farmers income
X_4 = training
X_5 = access to credit
X_6 = membership of an association
X_7 = farm size in hectares
X_8 = sex
X_9 = extension contact
X_{10} = farming experience
$\beta 0$ = constant
βis = parameters to be estimated, and
$\mathcal{E}i$ = error-term

3. RESULTS

Nine RARC mangrove rice varieties (CP 4, ROK 4, ROK 5, ROK 8, ROK 9, ROK 10, ROK 21, ROK 22 and ROK 23) were identified and the 600 farmers were interviewed about their knowledge and use of these varieties. Data and information were gathered using the data collection tool developed for this purpose. Both qualitative and quantitative data were collected and analysed. The list of mangrove rice varieties was provided by the breeding unit at RARC, so that all mangrove varieties developed at RARC by the breeding unit were captured in the research.

3.1. Knowledge of the improved mangrove rice varieties

- **CP 4**

A large proportion of the farmers interviewed know about the RARC-improved rice varieties. Most of the farmers in Kambia district know about all the RARC mangrove varieties; this is because the research centre (RARC) is located in this district and this enables them to easily know about and have access to these improved rice varieties. About 81% of farmers in Mambolo Chiefdom and 61% of those in Samu Chiefdom know about CP 4.

- **ROK varieties**

It is estimated that 66% of farmers in Mambolo and Samu Chiefdoms know about ROK 4. Also, ROK 5 is known to 97% of farmers in Mambolo Chiefdom and 98% of farmers in Samu Chiefdom. ROK 8 is known by 36% of farmers in Mambolo Chiefdom and 34 % of farmers in Samu Chiefdom. ROK 9 is known by a relatively smaller proportion of farmers - 34% in Mambolo and Samu Chiefdoms. About 98 % of farmers in Mambolo Chiefdom and 88% of those in Samu Chiefdom are familiar with ROK 10. These compare with 51% of farmers in Mambolo Chiefdom and 26% in Samu Chiefdom who know about ROK 21. ROK 22 is known by 60% of farmers in Mambolo Chiefdom and 22 % of those in Samu Chiefdom. ROK 23 is known by 48% of farmers in Mambolo Chiefdom and 24 % of farmers in Samu Chiefdom.

Farmers in Port Loko and Moyamba districts are more knowledgeable about ROK 4, ROK 5 and ROK 10 because these varieties are more popular in mangrove rice farming communities than the other mangrove rice varieties. Farmers in Kaffu Bullom Chiefdom know about ROK 4 (61%), ROK 5 (92 %), and ROK 10 (34%).

3.2. Mangrove rice varieties grown at least once by farmers

Table 2 shows that ROK 5, ROK 10 and CP 4 are the most cultivated of the mangrove rice varieties and have been grown at least once by some farmers in all the districts – ROK 5 (380 farmers); ROK 10 (315 farmers); and CP 4 (99 farmers) in 2014. In Kambia district, CP 4 was grown at least once by 44% farmers in Mambolo Chiefdom and 33% in Samu Chiefdom. However, ROK 8, ROK 9, ROK 21, ROK 22 and ROK 23 were not widely grown by farmers because they were not aware of their existence. Also, ROK 9, ROK 21 and ROK 22 have never been grown by farmers in Moyamba district because these varieties are not accessible. Finally, ROK 21 and ROK 23 have not been grown by farmers in Port Loko district due to issues relating to awareness, exposure and accessibility.

3.3. Adopters of RARC mangrove rice varieties

The number of farmers who cultivated the varieties at least once and who have continued to cultivate them up to 2014 is provided in Table 3. ROK 5 and ROK 10 are the most cultivated rice varieties (163 farmers still cultivate ROK 5 and 86 farmers still cultivate ROK 10). ROK 4 and CP 4 were also grown by quite a reasonable number of farmers in all the districts surveyed (30 farmers for ROK 4 and 23 farmers for CP 4). In 2014, ROK 8 was not cultivated in Samu, Lokomasama and Bumpeh Chiefdoms; ROK 21 and ROK 22 were not cultivated in Port Loko and Moyamba districts; ROK 23 was cultivated by only one farmer in Samu Chiefdom in Port Loko district and one farmer in Ribbi Chiefdom in Moyamba district. The reasons for varieties not being cultivated are a lack of awareness, availability and accessibility. In this regard, ROK 5 and ROK 10 are the varieties that are mostly readily available to farmers and are, therefore, the most adopted ones.

3.4. Non-adopters of RARC mangrove varieties

Table 4 shows the number of farmers who cultivated the varieties at least once but discontinued their cultivation - ROK 5 (217 farmers); ROK 10 (127 farmers); CP4 (76 farmers); and ROK 4 (68 farmers). The reasons given for non-adoption were the lack of skilled labour for the various farm operations and the lack of training and extension service. The low levels of adoption of the remaining mangrove rice varieties were due to the lack of awareness of the existence of the varieties. These results reveal that a large number of mangrove farmers did not adopt RARC mangrove rice varieties because of the lack of skilled labour, training, extension visits and awareness of the varieties.

3.5. RARC mangrove rice varieties lost by farmers

Table 5 provides information on farmers who cultivated the varieties at least once but stopped their cultivation because they lost the varieties. This is a serious problem because it is difficult for farmers to regain lost varieties. Farmers reported that varieties were lost due to admixture and the civil war. ROK 5 and ROK 10 were the most affected - 172 farmers lost ROK 5 while 112 lost ROK 10 – but other varieties were also lost (Table 5). Farmers indicated their interest in cultivating the lost varieties should they become available again.

3.6. RARC mangrove rice varieties abandoned by farmers

Table 6 shows the number of farmers that cultivated the RARC varieties at least once but abandoned them because of high bird damage and the lack of access to seed. The abandonment rate was high for ROK 5 (43 farmers), CP 4 (22 farmers), ROK 4 (19 farmers) and ROK 10 (16 farmers).

3.7. Probit model results

The usage of the rice varieties in the 2014 cropping season was regressed against farmers' socio-economic variables, which include farmers' age , education, income, training, access to credit, membership of an association, farm size, sex, extension contact and farming experience. These variables were chosen based on the findings of previous studies on technology adoption in developing countries (see Tiamiyu *et al*., 2009; Sita & Ponnarasi, 2009).

The influence of age on adoption decision depend on experience, wealth, authority, risk taking and consumers/workers ratio in the household. Older farmers may have more experience, authority and wealth, while younger farmers might be less risk-averse, may have greater access to information and have higher consumer/workers ratio but lack experience and resources. Thus, older farmers are expected to be positively related to adoption. Age can either be positively or negatively correlated with adoption decision. The coefficient of age carries a negative sign and is significant in adoption decision. This indicates that younger farmers are more likely to be interested in adopting new technologies if they are not constrained by cash resources, while older farmers are less likely to be able to use new technologies if they require extra physical labour and/or older farmers may be less interested because they are more risk-averse.

Education is expected to affect the level of technology adoption positively through effective skill acquisition in choosing better inputs. In this study, the coefficient of education carries the expected sign and is significant in influencing the adoption of the varieties. Therefore, farmers that are educated (literate) are more likely to adopt new technologies than those that are not.

Income derived from farming activities indicates the level of profit of the farmers. The expectation is that farmers will be able to plough back profit from their previous farming into future production process in order to increase profit. Farmers with more income are likely to be able to afford and apply expensive inputs aimed at increasing productivity; hence income is expected to influence technology adoption positively. The result from the Probit does not carry the expected sign and is not significant.

Training acquired for rice farming is expected to affect adoption of technology positively, since farmers acquired better skills to carry out their farming activities. The result carries the expected sign and is significant. This proves that farmers who benefitted from training are more likely to adopt technologies than those who did not benefit from any training.

Access to credit is expected to assist farmers to purchase necessary inputs for rice production and pay for hired labour. Many sources of credit give the farmer more chances of securing improved inputs. They also provide farmers with an additional source of investment in new ideas and therefore is expected to be positively related to technology adoption. In this study, access to credit carries the expected sign and is significant. This indicates that the more farmers have access to credit facilities the better their chances of adoption of improved technologies.

Membership of an association is expected to assist farmers to have easy access to credit and other production inputs. It can also enhance access to technological information. The sign of the parameter of this variable is expected to be positive. The result carries the expected sign but is not significant. This indicates that gaining membership of an association is not enough reason for farmers to adopt a technology.

Information on the influence of farm size on adoption decision is important in order to identify the appropriateness of a technology for a range of farm sizes. The influence of farm size on the decision to adopt depends on the technology (Jha *et al.,* 1991). Farm size carries a positive coefficient and is significant, suggesting that farm size has a significant positive influence on adoption decision. In the surveyed districts, the improved varieties are cultivated for both subsistence and commercial purposes, thus making adoption of the varieties more attractive to farmers.

The role of gender in rice farming is important. A dummy variable was used to specify the sex of the respondent, 1 for a male respondent and 0 for a female respondent. Male farmers have better access to the resources needed to use improved technologies. They are, therefore, expected to be positively related with the adoption of improved varieties. Women contribute about 70% of the labour used for agricultural production in Sierra Leone but farming resources are mostly controlled by men (Lakoh, 1996). The coefficient of the result is negative and significant in influencing adoption decision. This means that gender significantly influences adoption decision negatively. The result obtained indicates that female farmers were therefore more likely to adopt improved rice varieties, probably because NGOs favour women in the distribution of seed of improved rice varieties.

Extension contact is a very important determinant of technology adoption because newly developed technology is introduced to farmers through the activities of extension agents. A farmer whose contact with extension agents is very high is expected to be more familiar with and more knowledgeable about the use of improved agricultural innovations. This variable is expected to be positively related to technology adoption. The result has the expected sign and is significant in determining the adoption of the varieties.

Farming experience could take on either a negative or positive sign depending on the length of the period involved. It is expected to demonstrate increasing returns up to a stage and later diminish as more elderly farmers have been reported to be more risk averse, hence less likely to experiment with new technologies. In this study, farming experience carries the expected sign and also has a significant influence on adoption.

4. CONCLUSIONS

Nine RARC mangrove rice varieties (CP 4, ROK 4, ROK 5, ROK 8, ROK 9, ROK 10, ROK 21, ROK 22 and ROK 23) were identified. Most farmers in Kambia district are knowledgeable about all the RARC varieties but farmers in Port Loko and Moyamba districts are more knowledgeable about ROK 4, ROK 5 and ROK 10. In all the districts surveyed, ROK 5 and ROK 10 are the most known varieties. A significant proportion of farmers (528) know about ROK 5 and 321 farmers know about ROK 10.

The percentages on the knowledge and use of the varieties indicate that some varieties are specific to some areas while others are grown in several localities. A constraint was, however, the fact that improved rice varieties are given local names linked to the source of access, the performance of the variety or physical traits.

In the 2014 cropping season, for farmers who are still cultivating the varieties (i.e. the adopters), ROK 5 and ROK 10 are the most adopted RARC varieties. ROK 4 and CP4 were adopted by quite a reasonable number of farmers in all the districts surveyed - ROK 4 by 30 farmers and CP 4 by 23 farmers. The number of non-adopters is high for ROK 5 and ROK 10. The reasons given were the lack of skilled labour for various farm operations, lack of training and extension service.

Loss of variety was recorded for all the varieties but ROK 5 and ROK 10 recorded the highest loss due to admixture and the civil war. Farmers indicated their interest in cultivating the lost varieties if they have access to them.

The cultivation of RARC varieties at least once is high particularly for ROK 5, ROK10 and ROK4. In 2014, however, the cultivation rate dropped, indicating the abandonment and loss of varieties. Reasons given were the lack of access to seed of RARC varieties, admixture and the high rate of bird damage to the varieties. Seed of RARC varieties with awns should be made available and accessible to mangrove rice farmers. The availability of and easy access to improved varieties with awns can increase production and help reduce bird damage.

All the variables in the probit model, except farm income and sex, have the expected signs and eight are significant in explaining the use of the RARC improved rice varieties. The positively related and significant variables are farmers' level of education, training, access to credit, farm size, extension contact and farming experience, as expected. This means that improvements in these major factors would lead to higher levels of technology adoption.

4.1. Recommendations

To improve the adoption of improved rice varieties, the following recommendations can be useful.

1. Seed of RARC mangrove varieties should be made available and accessible to mangrove rice farmers
2. Farmers should be provided with credit
3. Extension services should not be biased against women
4. Adult literacy facilities should be establish in farming communities

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Appendix

Table 1: Knowledge of RARC mangrove rice varieties

District	Chiefdom	Knowledge of Variety									
		CP4		ROK 4		ROK 5		ROK 8		ROK 9	
		Count	%	Count	%	Count	%	Count	%	Count	%
Kambia	Mambolo	81	81.0	66	66	97	97	36	36	34	34
	Samu	61	61.0	66	66	98	98	34	34	34	34
Port Loko	Kaffu Bullom	26	26.0	61	61	92	92	15	15	14	14
	Lokomasama	32	32.0	46	46	90	90	17	17	17	17
Moyamba	Bumpeh	22	22.0	21	21	89	89	6	6	9	9
	Ribbi	20	20.0	31	31	62	62	8	8	7	7
	Total	242		291		528		116		115	

District	Chiefdom	ROK 10		ROK 21		ROK 22		ROK 23	
		Count	%	Count	%	Count	%	Count	%
Kambia	Mambolo	98	98	51	51	60	60	48	48
	Samu	88	88	26	26	22	22	24	24
Port Loko	Kaffu Bullom	34	34	1	1	5	5	4	4
	Lokomasama	61	61	15	15	11	11	11	11
Moyamba	Bumpeh	24	24	5	5	4	4	4	4
	Ribbi	16	16	6	6	4	4	5	5
	Total	321		104		106		96	

Table 2: Mangrove rice varieties grown at least once by farmers

District	Chiefdom	Grown Variety at least once									
		CP 4		ROK 4		ROK 5		ROK 8		ROK 9	
		Count	%	Count	%	Count	%	Count	%	Count	%
Kambia	Mambolo	44	44	22	22	88	88	6	6	5	5
	Samu	33	33	20	20	84	84	8	8	8	8
Port Loko	Kaffu Bullom	6	6	28	28	57	57	4	4	2	2
	Lokomasama	7	7	12	12	57	57	1	1	1	1
Moyamba	Bumpeh	7	7	4	4	61	61	0	0	0	0
	Ribbi	2	2	12	12	33	33	2	2	0	0
	Total	99		98		380		21		16	

District	Chiefdom	ROK 10		ROK 21		ROK 22		ROK 23	
		Count	%	Count	%	Count	%	Count	%
Kambia	Mambolo	94	94	11	11	29	29	12	12
	Samu	68	68	7	7	5	5.	6	6
Port Loko	Kaffu Bullom	10	10	1	1	1	1	0	0
	Lokomasama	33	33	2	2	0	0	1	1
Moyamba	Bumpeh	4	4	0	0	1	1	0	0
	Ribbi	6	4	1	1	0	0	1	1
	Total	215		22		36		17	

Table 3: Adopters of RARC mangrove rice varieties

District	Chiefdom	Adopters - Still Grown the Variety							
		CP 4		ROK 4		ROK 5		ROK 8	
		Count	%	Count	%	Count	%	Count	%
Kambia	Mambolo	11	17.5	5	7.9	40	63.5	1	1.6
	Samu	4	21.1	2	10.5	11	57.9	0	0
Port Loko	Kaffu Bullom	1	3.3	14	46.7	23	76.7	1	3.3
	Lokomasama	0	0	1	4	19	76	0	0
Moyamba	Bumpeh	5	10.6	2	4.3	45	95.7	0	0
	Ribbi	2	7.4	6	22.2	25	92.6	2	7.4
	Total	23		30		163		4	

District	Chiefdom	ROK 10		ROK 21		ROK 22		ROK 23	
		Count	%	Count	%	Count	%	Count	%
Kambia	Mambolo	53	84.1	1	1.6	4	6.3	0	0
	Samu	9	47.4	0	0	0	0	1	5.3
Port Loko	Kaffu Bullom	3	10	0	0	0	0	0	0
	Lokomasama	15	60	0	0	0	0	0	0
Moyamba	Bumpeh	2	4.3	0	0	0	0	0	0
	Ribbi	4	14.8	0	0	0	0	1	3.7
	Total	86		1		4		2	

Table 4: Non-adopters of RARC mangrove varieties

District	Chiefdom	Non-adopters									
		CP4		ROK 4		ROK 5		ROK 8		ROK 9	
		Count	%	Count	%	Count	%	Count	%	Count	%
Kambia	Mambolo	33	75	17	77.3	48	54.6	5	83.3	5	100
	Samu	29	87.9	18	90	73	86.9	8	100	8	100
Port Loko	Kaffu Bullom	5	83.3	14	50	34	59.6	3	75	2	100
	Lokomasama	7	100	11	91.7	38	66.7	1	100	1	100
Moyamba	Bumpeh	2	28.6	2	50	16	26.2	0	0	0	0
	Ribbi	0	0	6	50	8	24.2	0	0	0	0
	Total	76		68		217		17		16	

District	Chiefdom	ROK 10		ROK 21		ROK 22		ROK 23	
		Count	%	Count	%	Count	%	Count	%
Kambia	Mambolo	41	43.6	10	90.9	25	86.2	10	100
	Samu	59	86.8	7	100	5	100	5	83.3
Port Loko	Kaffu Bullom	7	70	0	0	1	100	0	0
	Lokomasama	18	54.5	0	0	0	0	0	0
Moyamba	Bumpeh	2	50	0	0	0	0	0	0
	Ribbi	0	0	0	0	0	0	0	0
	Total	127		17		31		15	

Table 5: RARC mangrove rice varieties lost by farmers

District	Chiefdom	Varieties Lost									
		CP4		ROK 4		ROK 5		ROK 8		ROK 9	
		Count	%	Count	%	Count	%	Count	%	Count	%
Kambia	Mambolo	24	54.5	12	54.5	37	42	5	83.3	3	60
	Samu	26	78.8	12	60	69	82.1	6	75	8	100
Port Loko	Kaffu Bullom	1	16.7	13	46.4	27	47.4	3	75	1	50
	Lokomasama	3	42.9	5	41.7	22	38.6	0	0	0	0
Moyamba	Bumpeh	1	14.3	1	25	10	16.4	0	0	0	0
	Ribbi	0	0	6	50	7	21.2	0	0	0	0

	Total	55		49		172		14		12	

District	Chiefdom	ROK 10		ROK 21		ROK 22		ROK 23	
		Count	%	Count	%	Count	%	Count	%
Kambia	Mambolo	35	37.2	6	54.5	22	75.9	11	91.7
	Samu	59	86.8	7	100	5	100	5	83.3
Port Loko	Kaffu Bullom	2	20	1	100	1	100	0	0
	Lokomasama	13	39.4	2	100	0	0	1	100
Moyamba	Bumpeh	1	25	0	0	1	100	0	0
	Ribbi	2	33.3	1	100	0	0	0	0
	Total	112		17		29		17	

Table 6: RARC mangrove rice varieties abandoned by farmers

		Abandonment Rate									
District	Chiefdom	CP4		ROK 4		ROK 5		ROK 8		ROK 9	
		Count	%	Count	%	Count	%	Count	%	Count	%
Kambia	Mambolo	9	20.5	5	22.7	9	10.22	0	0	2	400
	Samu	3	9.1	6	30	4	4.8	2	25	0	0
Port Loko	Kaffu Bullom	4	66.7	1	3.6	7	12.3	0	0	1	50
	Lokomasama	4	57.1	6	50	16	28.1	1	100	1	100
Moyamba	Bumpeh	2	28.6	1	25	6	9.8	0	0	0	0
	Ribbi	0	0	0	0	1	3	0	0	0	0
	Total	22		19		43		3		4	

District	Chiefdom	ROK 10		ROK 21		ROK 22		ROK 23	
		Count	%	Count	%	Count	%	Count	%
Kambia	Mambolo	6	6.4	4	36.4	3	10.3	1	8.3
	Samu	0	0	0	0	0	0	1	16.7
Port Loko	Kaffu Bullom	4	4	0	0	0	0	0	0
	Lokomasama	5	15.1%	0	0	0	0	0	0
Moyamba	Bumpeh	1	25.0	0	0	0	0	0	0
	Ribbi	0	0	0	0	0	0	0	0
	Total	16		4		3		2	

Table 7: Parameter estimates for probit model

		Parameter Estimates			
	Parameter	Estimate	Std. Error	Z	Sig.
PROBIT[a]	Age	-0.126***	0.187	-0.673	0.005
	Educational level	0.014***	0.047	0.291	0.010
	Farmer's income	-0.166	0.056	-2.964	0.255
	Training	0.055*	0.023	2.391	0.065
	Access to credit	0.202**	0.192	1.052	0.038
	membership of association	0.010	0.159	0.060	0.352
	Farm size	0.044***	0.022	2.000	0.008
	Sex	-0.167***	0.183	-0.912	0.009
	Extension contact	0.289***	0.325	0.889	0.007
	Farming experience	0.072**	0.096	0.750	0.041
	Intercept	0.369	1.080	0.341	0.733

a. PROBIT model: PROBIT(p) = Intercept + BX

Note: ***, ** and * indicate significance at 1 percent, 5 percent and 10 percent probability levels, respectively