Afropolitan Journals

ISSN: 3027-2637 www.afropolitanjournals.com

Assessment of Farmers' Willingness to Adopt Rice-Cum-Fish Technology in Edo and Delta States, Nigeria

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Abstract

Strengthening rice farmers' economic profile requires seeking alternative production systems to boost their livelihood; however, of pertinent interest is the readiness of the farmers to incorporate recommended technologies into the existing production system. This paper, therefore, examines the adoption prospects of rice-cum-fish technology among rice farmers in Edo and Delta States of Nigeria. The technology was piloted by the Nigerian Institute for Oceanography and Marine Research (NIOMR), and targeted at rice farmers with the hope of enhancing income and food security. Data were collected using a validated questionnaire from 355 farmers, sampled from 18 communities across six local governments in the study area. Analysis of data was done using descriptive statistics, logit regression, and binomial tests. Results revealed the farmers were aware of some of the rice-cum-fish production technologies especially when fish enter the rice field from the river/stream (47.89%). The majority (81.13%) of the respondents expressed willingness to adopt any of the rice-cum-fish production technologies, and Binomial test results ($p < 0.05$) indicate this proportion was significant, compared to those who expressed unwillingness. This indicates a high prospect for the adoption of the technology among the farmers in the study area, when introduced. Significant factors found to influence the respondents' likelihood of adopting the proposed technology were age (b=0.08), sex (b=2.91), educational level (b=-1.22), farming experience (b= -0.08), farm size (b = 0.93) and intercrop status (b=1.15). The study thus recommends proper extension targeting of farmers to convince the latter of the need to adopt the rice-cum-fish technology.

Keywords: *Rice-Cum-Fish Technology, Adoption, Agricultural Extension, Edo, Delta, Nigeria*.

Introduction

Rice, a cereal grain, is the most widely consumed staple food for most of the world's population. It is relatively easy to produce and is grown for sale and home consumption. In Nigeria, rice is a food crop for which the country has abundant natural and human resources to produce, not just to meet local demand but also for exports. Besides, they are staple foods for the Nigerian populace for which the nation needs to be self-sufficient and build food security (Ekundayo, 2023). Though notwithstanding, the high demand for rice in Nigeria and that it's produced in the six agro-ecological zones of the nation, there is still a massive demand and supply gap. According to (Yusuf et al., 2020; Otto et al., 2021;

Ekundayo, 2023), over the years, the country has continued to depend on the importation of rice to meet the local demand and preference for her teeming population until recently the government placed a ban on the importation of rice in the country. Rice import has increased over the years and constituted grave concern to the government, prompting it to intervene in the rice economy. The Central Bank of Nigeria first implemented the restriction of official forex sales on the import of certain commodities. In June 2015, the CBN restricted access to forex for 41 items at the Nigerian foreign exchange market which it said could be produced in Nigeria. Top among the items on the list are agricultural items like rice, fish, chicken, eggs, turkey, palm kernel/palm oil products/vegetable oil, and tomatoes/tomato pastes.

A major challenge facing the country is food insecurity. Addressing this insecurity requires promoting alternative forms of food production. The rice-fish culture is an alternative form; rice-fish culture is small-scale aquaculture in rice-based farming systems. Agriculture and aquaculture are two major components of biological production with equal importance in providing livelihood, food security, economy, employment, and export earnings (FAO, 2019). The culture of fish in rice fields holds the potential to improve the productivity of low-income rice farmers and meet the soaring demand for food. In realization of this, the Nigerian Institute for Oceanography and Marine Research (NIOMR) has carried out training on the commercialization of integrated rice-cum-fish farming in coastal wetlands for rice and fish farmers in some states in the country such as Lagos and Ondo States. This training, funded by the World Bank/West Africa Agricultural Productivity Programme (WB/WAAPP) and Agricultural Research Council of Nigeria (ARCN) in 2015, had the objective of promoting the commercialization of rice-cum-fish culture in the coastal wetland for increased food production through the training and capacity building of youths, women, and men in coastal wetlands of South-West Nigeria. However, a major concern has been farmers' willingness to adopt this integrated farming system i.e., rice-cum-fish culture. This is because the farmers have not been used to this type of farming system. The success of this technology, therefore, hinges on the extent to which the farmers are willing to integrate it into their current farming practices.

Objectives of The Study

The main objective of this paper is to ascertain the prospects of rice-cum-fish production technology among rice farmers in Edo and Delta States of Nigeria. The specific objectives are to:

i. examine the socio-economic profile of rice farmers in the study area;
ii. ascertain the farmers' willingness to adopt rice-cum-fish farming technology; and
iii. determine the factors that are likely to influence the farmers' adoption of the rice-cum-fish production technology.

Hypotheses of The Study

The following hypotheses were tested:

Ho_1: There is no significant relationship between farmers' socio-economic characteristics and their willingness to adopt rice-cum-fish production technology.

Ho_2: There is no significant difference in the proportion of farmers willing to adopt the rice-cum-fish production technology in the study area.

Methodology

The study area is limited to Edo and Delta States of Nigeria. Delta State lies between Latitude 5°00' and 6° 30' N of the equator and Longitude 5° 00' and 6° 45'E of the Greenwich meridian. It occupies a land area measuring 17,440km², of which about a third is waterlogged and swampy (Delta State Diary, 2008). The projected population figures of the State in 2020 are 5,663,362 based on a 3.2% annual growth rate (NBS, 2017). Edo State lies between Latitude 5° 44' and 7° 34' N of the equator and Longitude 5° 04' and 6° 43' E of the Greenwich meridian (Edo State Diary, 2014). It occupies a land area of about 17,902km², with an estimated population of 4,235,595 in 2020 (NBS, 2017). The majority of the people in the state are farmers or engage in farm-related enterprises. Some major crops grown in both States are cassava, rice, and yam. Fishing is equally common, especially along the coastal areas.

Data for the study were collected from a primary source, namely rice farmers in the study area using a validated and pretested question instrument (questionnaire). The study employed a multi-stage sampling procedure, comprising purposive and random sampling techniques. This was so because the targeted areas were coastal wetlands. The various stages are explained below: In Stage 1, three (3) local government areas (LGAs) each in Delta and Edo States, which have an abundance of wetlands, were purposively sampled for the study. This made a total number of six. The selected LGAs were based on data obtained from NIOMR and validated with the various State ADPs. In stage 2, three communities were purposively selected in each LGA, to give a total of 18. The criterion for their selection was equally based on the areas being wetland. Given that the population of the target respondents (rice farmers) is unknown, the sample size of 384, which is recommended under such circumstances (Smith, 2017) was chosen. Twenty-two rice farmers from the selected communities were chosen using a snowballing technique. This value was arrived at by selecting an equal sample across the selected communities since the population of the target respondents per community was unknown. This gave a total of 396.

The respondents were administered a validated questionnaire. Contact with these farmers was made possible by personnel of the ADP and NIOMR in the two States. The field response was 355, which represents about 89.6% response rate. Descriptive and inferential statistics were used to analyze the data. The descriptive statistical tools used included frequency count, percentages, and means, while logit regression and binomial test were used to test the hypotheses. Logit regression is an inferential statistic that assesses the relationship between one or more independent variables and a dichotomous dependent

variable (Sperandei, 2014), while the binomial test is used to test the significance of the difference in proportion of a variable having only two outcomes (Frey, 2018) e.g., as applicable in this study, willingness and unwillingness of farmers to adopt the technology.

The mathematical representation of the regression model is specified as:

$P\ (^{Yi}/_{1-Yi}) = a + b_1X_1 + b_2X_2 + \ldots\ldots\ldots + b_nX_n + e$

Where

P= a dummy variable

a = the coefficient on the constant term

b = the coefficient on the independent variable(s)

X = the independent variable (s)

e = error term

Where;

Y = Willingness to adopt rice-cum-fish farming (Dummy variable: *willing=1, not willing = 0*)

Explanatory variables:

X_1 = age (measured in years)

X_2 = education (years of formal school education)

X_3 = gender (dummy: male =1; female = 0)

X_4 = household size (number of people feeding from the same pot)

X_5 = farm size (hectares)

X_6 = farming experience (years)

X_7 = extension contact (dummy: yes = 1; no = 0)

X_8 = intercrop status (diversified cropping =1; sole cropping = 0)

Results and Discussion

Socio-economic characteristics of respondents

The socio-economic profile of the respondents (Table 1) revealed that male-dominated rice production in the study area with a percentage of 66.76%, while females constitute 33.24%. The tedious tasks associated with rice cultivation may account for this low participation of women. This fact was buttressed by Agboh-Noameshie *et al*. (2013) and Dilek *et al. (*2018) who reported that women tend to dominate the crop's processing aspect, not its cultivation. The age range indicates that the average young individuals largely undertake rice cultivation with a modal age range of 31-50 years (about 71%). This suggests that persons do rice cultivation with the energy to manage the production practices and cope with the energy (labour) demand.

The result shows married persons (85.92%) were largely involved in rice cultivation in the study area, which suggests that the need to cater for their families may be a motivation for this livelihood engagement. The household sizes suggest the respondents had household members depending on them; the average household size was about five, with the modal size being 1-4 (36.05%). The educational distribution shows the highest proportion of the respondents (36.05%) had post-secondary education. This implies that the majority of them

are learned. This validates the assertion of (Kafando et al, 2022), that when a farmer is educated, the higher the chances of adopting new technologies or farming systems such as the rice-cum-fish technology. About half of the respondents (50.99%) had cultivated rice for the last ten years, while 25.92% had been involved in rice cultivation for 11-20 years. These findings suggest the respondents were experienced in rice cultivation and may appreciate the need to incorporate fishery into their present farming system.

Many of the respondents (63.94%) were farming on rented land, with only a few (10.7%) having complete ownership of the land. This has implications for the nature of investment that can be done on the land. According to Mazhar et al (2021); Adesida et al, (2021), empirical evidence shows that farmers who own their land are more inclined to adopt technologies since they will be more open to making capital investments in their farming enterprise. In terms of usage, the modal size of the farmland was 2ha and below, the average being about 2ha. This indicates that the respondents were small-scale farmers, and this has implications on the yield and income achievable, with lower yields associated with smaller farms (Yengoh, 2012).

Table 1: Socio-economic profile of respondents

Characteristics	Options	Delta (n=180)		Edo (n=175)		Total (n=355)	
		Freq	%	Freq	%	Freq	%
Sex	Female	51	28.33	67	38.29	118	33.24
	Male	129	71.67	108	61.71	237	66.76
Age range (years)	<= 30	40	22.22	16	9.14	56	15.77
	31 – 40	64	35.56	55	31.43	119	33.52
	41 – 50	64	35.56	69	39.43	133	37.46
	51 – 60	8	4.44	28	16.00	36	10.14
	61+	4	2.22	7	4.00	11	3.10
Marital Status	Single	36	20.00	13	7.43	49	13.80
	Married	144	80.00	161	92.00	305	85.92
	Widow(er)	0	.00	1	.57	1	.28
Educational level	No formal education	0	.00	19	10.86	19	5.35
	Adult education	5	2.78	8	4.57	13	3.66

	Primary education	24	13.33	78	44.57	102	28.73
	Secondary education	37	20.56	56	32.00	93	26.20
	Post-secondary	114	63.33	14	8	128	36.05
Household size	1-4	98	54.44	18	10.29	116	32.68
	5-8	50	27.78	65	37.14	115	32.39
	9-12	20	11.11	39	22.29	59	16.62
	>12	12	6.67	53	30.29	65	18.31
Farming experience (years)	<= 10	131	72.78	50	28.57	181	50.99
	11 – 20	21	11.67	71	40.57	92	25.92
	21 – 30	16	8.89	32	18.29	48	13.52
	31 – 40	8	4.44	16	9.14	24	6.76
	41+	4	2.22	6	3.43	10	2.82
Source of farmland	Purchased	29	16.11	9	5.14	38	10.70
	Rented	146	81.11	81	46.29	227	63.94
	Inherited	5	2.78	85	48.57	90	25.35
Years of farmland use	10 & below	134	76.57	119	68	253	72.28
	11 – 20	9	5.15	38	21.72	47	13.43
	21+	32	18.28	18	10.29	50	14.29
Contact with extension agents	No	58	32.22	172	98.29	230	64.79
	Yes	122	67.78	3	1.71	125	35.21
Size of plot (ha)	2 & below	139	95	33	20	172	55
	2.1 - 5.0	8	5	107	64	115	37
	>5.0	0	0	27	16	27	9
Intercrop status	sole rice	85	47.22	63	36.00	148	41.69
	Practice intercropping with rice	95	52.78	112	64.00	207	58.31

Field survey, 2017

Rice-cum-fish technologies aware of

Figure 1 shows close to half of the respondents were aware that rice can be grown with fish gaining access directly from the river/stream, 17.18% were aware that rice and fish can be cultivated/reared on different parts of the same farmland, 12.39% were aware of rice and fish being grown alternatively on the same piece of land, while 7.04% claimed to be aware that rice and fish can be grown/reared concurrently. The results indicated a rather low awareness among respondents of the different rice-cum-fish technologies available.

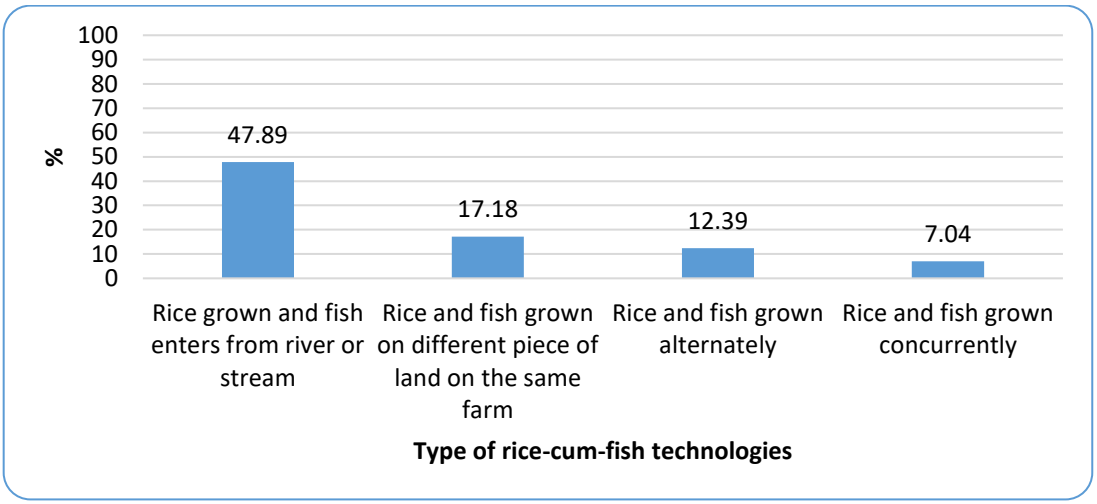

Fig. 1: Rice-cum-fish production technologies awareness by respondents.

Willingness to adopt any of the rice-cum-fish technologies

Table 2 captures the respondents' willingness to adopt rice-cum-fish production technology. Based on the results, the majority (81.13%) indicated a willingness to integrate the system into their current farming system. Only 18.87% were reluctant. Binomial test was applied to determine if the difference in willingness response among the respondents was significant. Using a test proportion of 50% (i.e., 0.50), the results (*willing = 0.81; not willing = 0.19*) were significant ($p < 0.05$), which indicates that a significant proportion of the respondents were indeed willing to adopt the rice-cum-fish production technology. The findings suggest a good prospect for the technology in the study area if introduced.

Table 2: Respondents willingness to adopt rice-cum-fish technology.

Willing status	Delta		Edo		Total	
	Freq	%	Freq	%	Freq	%*
Willing	142	78.89	146	83.43	288	81.13
Not willing	38	21.11	29	16.57	67	18.87
Total	180	100.00	175	100.00	355	100.00

** Binomial test = Probability level for difference in proportion is significant ($p < 0.01$)*

Factors affecting respondents' willingness to adopt Rice-cum-fish technologies

Logit regression was used to determine those factors that have a significant influence on the likelihood of the respondents adopting the proposed rice-cum-fish technology. The

results (Table 3) show the regression model is significant ($\chi^2 = 167.72; p < 0.05$), which means the socio-economic parameters included in the model exert a significant influence on the respondent's likelihood of incorporating the technology into their farming practices. The Goodness-of-fit test ($\chi^2 = 169.91; df = 153; p>0.05$), which is a chi-square test that measures the variability between the logit model and real-life or observed data i.e. how well the logit model fits the real-life data, is not significant. This means the logit model is closely aligned with the real-life data, indicating the model is a 'good' fit

An examination of the individual chi-square results indicates that six variables or parameters were significant, namely age, sex, educational level, farming experience, farm size, and intercrop status of the farmers. Age (b = 0.084) was positively signed which means that older rice farmers were about 9% (Odd ratio = 1.09) more likely to adopt the rice-cum-fish technology compared to the younger farmers. This was contrary to apriori expectations as older individuals have been described as risk-averse and unwilling to try new things for fear of failure (Oluwatayo and Omowunmi, 2015). It is possible that older farmers, given their longer farming experience, may have come to appreciate the need to incorporate the recommended technology into their existing production system to boost income.

The result for sex was positive (b = 2.905), implying that male rice farmers were 18 times (odd ratio = 18.26) more likely to adopt the technology. The additional burden that the adoption of the technology will impose on the farmer may account for the significantly low willingness of female farmers to embrace the technology. The result for inter-crop status (b = 1.159) shows that farmers who were diversified in their cropping were three times (odd ratio = 3.18) more likely to adopt the rice-cum-fish technology. Farmers who operate a diversified enterprise may be more willing to take risks and embark on this 'new' technology.

Farm size was positively related to the respondent's likelihood of adopting the technology (b = 0.938). The odds ratio (2.55) implies that farmers with larger farms were about two times more likely to adopt the rice-cum-fish technology relative to farmers with less farm size. It is possible that farmers with larger farms can take a greater risk of implementing the technology and hence, their greater willingness to adopt the technology.

Table 3: Determinants of farmers' likelihood of adopting rice-cum-fish technology.

Parameters	Coefficient (b)	Chi-square Value	df	Prob. Level	Odd ratio
Constant	-444.232	0.319	1	0.57	
Sex	2.905*	12.837	1	0.00	18.265
Age	0.084*	5.583	1	0.01	1.088
Educational level	-1.227*	16.455	1	0.00	0.29
Household size	0.010	0.001	1	0.96	1.010

Farming experience	-0.087*	10.122	1	0.00	0.92
Farm size	0.938*	24.503	1	0.00	2.555
Intercrop status	1.159*	5.150	1	0.02	3.187
Frequency of extension contact	0.986	3.789	1	0.052	2.680

Model chi-square = 167.72; df = 16; p < 0.05

Goodness-of-fit (x2) = 169.909; df = 153; p>0.05

Coefficient of determination = 0.607

**Significant at 5%*

The Farming experience was negatively correlated with the farmers' likelihood of adopting the technology (b = -0.087), and with an odds ratio of 0.92, it indicates that the less experienced farmers were about 9% ($^{1}/_{0.92}$) more likely to adopt the rice-cum-fish technology compared to the more experienced farmers. It is possible the less experienced farmers were more willing to try out something new than the more experienced ones who may feel more comfortable with their old system of farming. The coefficient for education was negative (b = -1.227) with an odds ratio of 0.29, which implies that the less educated farmers were about three times more likely (odds ratio: $^{1}/_{0.29}$ = 3.4) to adopt the rice-cum-fish technology relative to the more educated farmers. It is possible that the less educated farmers were into rice production more on a full-time basis with possibly no other income sources thus making them more interested in adopting the technology to enhance their earnings.

Conclusion and Recommendations

The challenge of food security requires exploring every avenue to promote food availability. The development and promotion of the rice-cum-fish production technology is a good strategy in this direction. The findings of this study have shown there is a great prospect for the rice-cum-fish technology in the study area. However, the results of the study indicate the need for proper targeting of rice farmers to enhance the effectiveness of the dissemination or agricultural extension efforts. Thus, there is a need for an extension campaign targeted at specific categories of rice farmers to convince them of the need to adopt the rice-cum-fish technology. Specifically, the enlightenment program should target younger rice farmers, female, have smaller farm sizes, are more educated, and practice sole cropping.

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