



Adoption of Integrated Rice-Fish Farming Technology in Ebonyi State Nigeria: Socio-Demographic Characteristics and Availability of Technology

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Authors' contributions

This work was carried out in collaboration among all authors. Author ALO designed the study, carried out field visits, wrote the protocol and the first draft of the manuscript. Author CCO performed the data analysis, computational aspects and documentation. Author PAO provided guidance on literature search and data collection. Author MTU served as the overall supervisor and confirmed the accuracy of the results. All authors read and approved the final manuscript.

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ABSTRACT

Background: In order to meet the soaring demand for food, there is need for increased food production in Nigeria. Integrated Rice-fish farming is a significant approach to increase food production that will provide social, economic and environmental benefits.

Aim: To describe the socio-economic characteristics of integrated rice-fish farmers and to ascertain the availability of rice-fish farming technologies in the study area.

Study Design: This was a cross-sectional study. 243 farmers were assessed for their socio-economic characteristics and the availability of rice-fish farming technologies in the study area.

Methodology: Primary data were obtained from the field using structured questionnaire. The questionnaire contained questions that address the objectives of the study. Farmers were asked to

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indicate the rice-fish farming technologies available in the area. Descriptive and inferential statistical tools were used in achieving the objectives of the study in the form of Frequency score, Mean and Percentages.

Results: The result indicated that the majority (68.0%) of the farmers were male while 32.0% were female. The mean age of the farmers was 47 years. The result also showed that 79.8% of the farmers were, 9.5% of the farmers were single, while 10.7% were widowed. The result indicated that majority of the farmers 53.5% attained secondary school certificate, 21.8% had primary education. The result revealed that stocking of carp fish (78.60%), use of pests and disease resistant varieties (74.07%), use of organic fertilizer (61.73%), followed by transplanting of rice seedlings (69.96%) and skills in harvesting of rice before fish(53.50%) were the technologies perceived by the farmers as being the most available in the area.

Conclusion: The majority (68.0%) of the farmers were male while 32.0% were female and the technology that was most available to the farmers was stocking of carp fish.

Recommendations: There is need to encourage more females to engage in farming because female participation will have a positive multiplier effect not only on the family but on the entire community. Federal, State governments and Extension organizations must ensure that farmers are assisted in the use of available technology. The Extension agents should mount more aggressive awareness campaign in the area to enable more farmers embrace the practice of rice- fish farming.

Keywords: Agricultural technology; adoption; harvesting of fish before rice; stocking of carp.

1. INTRODUCTION

Nigeria as an agrarian country is abundantly endowed with rich arable land, water bodies, vegetation and active human population that support high productivity. Despite the oil boom of 1970s the agricultural sector has remained an important sector in the Nigerian economy [1]. Nigeria is the most populous nation in Africa with over 170 million people to feed, thus promoting increased cultivation of major staple crops like rice and the production of fish helps to secure food at homestead [2]. Rice (*Oryza sativa*) is a semi-aquatic plant which belongs to the family *Poaceae*. Its origin has been traced in South-east Asia, but today it is widely grown in other parts of Asia, America, and Africa. It is a cereal which has become a food of considerable strategic importance in many rapidly growing African cities, where its consumption among urban and rural poor households has increased considerably. In the South-east region of Nigeria, rice is grown mainly in Abakaliki, Bende, Eha-Amufu and Edda [3]. Its potential as a huge source of calories makes it a major food security commodity in Nigeria.

Central Bank of Nigeria [4] reported alarming protein gap in the nutrition of the Nigerian populace. According to the economic and financial review of 2014, an average Nigerian consumes only about 3.8gm of animal protein on daily basis as against the minimum requirement of 34gm per day. Thus, Nigeria was rated as one of the countries where the protein intake of the

people ranks among the lowest in the world [5]. However, a cheap, accessible and healthy source of protein is found in fish. Fish farming is an aspect of aquaculture which deals with the growth of fish in a controlled aquatic enclosure, such as ponds, lakes, reservoir and burrow pits [6]. The major species of fishes farmed in Nigeria include cat fishes (*Claria* and *Heterobranchus*), *Carp* and *Tilapia*, etc. According to [6], these fish species enjoy a good ecological relationship with rice and hence necessitated the practice of integrated rice and fish production. The practice of integrated rice-fish farming has been developed as a technological package with several component practices. Technology here implied or refers to inputs, methods, materials, techniques, processes, or practices used to maximize agricultural production, storage, processing and marketing [7]. The Rice-fish farming technological package is comprised of the following components: use of terracing, trench construction, bamboo guard construction, use of net guard, fingerling stocking, use of pesticides, resistant varieties of rice and supplies of fish, organic and inorganic fertilizers, rice-fish harvesting, rice seedling transplanting [8]. In this practice, rice and fish are raised side by side in separate compartment using the same water or an alternating system that is really a type of rotation culture, but distinct enough to warrant a separate section [6]. Fish is usually cultured within rice areas protected from excess flooding by small dikes. Fish are cultured in rice paddies either concurrently with rice or in rotation. It can optimize resource utilization through the

complementary use of land and water. While rice constitutes a major staple food and carbohydrate, source of calories, fish on the other hand, are rich in micro-nutrients and vitamins and thus human nutrition can be greatly improved through fish consumption, intensification, profitability and productivity.

Ecologically, integrated rice-fish farming improves soil fertility by increasing the availability of nitrogen and phosphorus to the soil. The natural aggregation of fish in rice field would inspire the combination of rice farming with fish to increase productivity [9]. Integrated rice-fish farming offers contribution to food, income and nutrition especially in form of carbohydrate and animal protein. To address the resultant gap in knowledge, it is pertinent to describe the socio-economic characteristics of integrated rice-fish farmers and to ascertain the availability of rice-fish farming technologies in the study area.

2. METHODOLOGY

2.1 Study Area

The study was conducted in Ebonyi state, Nigeria. Ebonyi state is one of the states of South East region of Nigeria. It derives its name from River Ebonyi. Ebonyi river arises from the Enugu highlands and cuts through Abakaliki. The capital and largest city in the state is Abakaliki. It has a land area of about 5,530 km² [10]. It lies within longitudes 7°30' and 8°30' E and latitudes 5°40' and 6°45' N [10]. It is bounded to the North by Benue state, to the West by Enugu state, to the East by Cross River state and to the South by Abia state. There are thirteen local government areas (LGAs) in the state namely: Abakaliki, Afikpo North, Afikpo South, Ebonyi, Ezza North, Ezza South, Ikwo, Ishielu, Ivo, Izzi, Ohaozara, Ohaukwu and Onicha. The tropical climate of the state is broadly of two seasons which are the rainy season between April and October and dry season between November and March. The temperature through the year ranges between 21°C to 29°C and humidity is relatively high. The annual rainfall varies from 2,000 mm in the Southern areas to 1,150 mm in the Northern areas. The state enjoys luxuriant vegetation with high forest zone (rain forest) in the south and sub-savannah forest in the northern region [11].

Ebonyi state is also known as the "salt of the nation" because of its large salt deposits. The people of Ebonyi state are predominantly farmers and traders. The main crops produced in the

state are rice, yam, palm produce, cocoa, maize, groundnut, plantain, banana, cassava, melon, sugar cane, beans, varieties of fruits and vegetables. Fishing was widely carried out in Afikpo. The state has abundant mineral resources such as lead, limestone, zinc and marble and huge salt deposit in Okposi and Uburu towns. It also has numerous rice processing mills, quarry factories, fertilizer blending plants, poultry farms and one of Nigerian's foremost cement factories formerly known as Nigerian cement company, Nkalagu [10].

2.2 Sampling Techniques

Multistage sampling procedure was used to select the sample for the study. The first stage involved the purposive selection of 9 Local Government Areas (LGAs) i.e. Ishielu, Ohaukwu, Izzi, Ikwo, Ezza North, Ezza South, Ohaozara, Afikpo South and Onicha from each of the three (3) agricultural zones Ebony North, Ebony South and Central of Ebonyi State where rice and fish farming are practiced. Secondly, sampling was done based on their high rice and fish farming activities thirdly one (1) village was randomly selected from each community and in the fourth stage nine (9) rice-fish farmers were purposively selected from a village based on their practice of rice-fish farming to give a sum total of 243 sample size rice-fish farmers for the study.

2.3 Data Collection

Data were collected from primary and secondary sources. Primary data were obtained from field using structured questionnaire. The questionnaire contained questions that address the objectives of the study.

2.4 Measurement of Variables

2.4.1 Objective I: Socio-economic variables

Age: was measured by asking the farmers to indicate their age in years in the space provided.

Sex: was measured by asking the farmers to indicate whether they were male or female and their response was recorded in dummy, male = 1 and female = 0.

Marital Status: The respondents were asked to indicate their marital status, and it was recorded and coded thus single=1, married =2, divorced =3 and widowed= 4.

Table 1. Distribution of sample frame

Agricultural zones	L.G.A.	Communities	Villages	No of rice cum fish farmers	
Ebonyi North	Ishielu	Ezillo	Amukpa	9	
		Nkalaha	Amagu	9	
		Nkalagu	Imoha	9	
	Ohaukwu	Effium, Umugudu, Umuezeaka		Akpu	9
				Azu Egu	9
				Agenyi	9
	Izzi	Ogbo-Agbaja Igbeagu Ndiezi		Ishiagu	9
				Ndiagu	9
				Nduogbu	9
Ebonyi Central	Ikwo	Akpan-wudele	Umuome	9	
		Igbudu	Echara	9	
		Eka-Awoke	Noyo-Alike	9	
	Ezza North	Amazu, Ekka Oriuzor		Onueke	9
				Ndiagu	9
				Umu-Ezeali	9
	Ezza South	Isieke Abina Agalaga		Amuzu	9
				Amana	9
				Ezzama	9
Ebonyi South	Ohaozara	Uburu	Obiozara	9	
		Okposi	Okposi-Okwu,	9	
		Akaeze	Umuobor	9	
	Afikpo South	Igli Amasiri Owutu Edda		Agbogo	9
				Amaozara	9
				Amachi	9
	Onicha	Isu Shiri Ukawu		Agba	9
				Isieke	9
				Amaofia	9
				243	

Education level: This was measured by asking the farmers to indicate their levels of educational attainment. Thus: No formal education =1, primary education =2, secondary education=3, Tertiary = 4.

Household size: The respondents indicated the number of people living with them under the same roof and feeding from the same pot.

Membership of social organization: The respondents were asked to indicate whether they belonged to any organization and their responses were recorded in a dummy; Yes = 1 and No = 0.

Size of farm land: The respondents were asked to indicate in hectares their available cultivated land.

Years of farming experience: The farmers were asked to indicate the number of years they had been into farming.

Monthly income: This was measured by asking the farmers to indicate the average amount they make per month in Naira.

Objective II: Farmers were asked to indicate the rice-fish farming technologies available in the area.

2.5 Method of Data Analysis

Descriptive and inferential statistical tools were used in achieving the objectives of the study. Frequency score, Mean and Percentage were used to achieve objectives I and II.

3. RESULTS AND DISCUSSION

3.1 Socio-demographic Characteristics

The socio-demographic variables investigated in this study include sex, age, marital status, household size, social organization membership, farm size, farming experience and monthly income. Table 1 shows the distribution of integrated rice-fish farmers by socio-demographic characteristics. The result indicated that the majority (68.0%) of the farmers were male while 32.0% were female. The findings were similar to [12] who found that more male farmers engage in rice and allied production activities. The causes of less participation of females may be attributed to the fact that they do not attend cooperative meetings and activities

where the farmers usually discuss new technologies and innovations. 24.2% of the farmers were in the age range 46-55 years, while 21.0% were 36-45 years. The mean age of the farmers was 47 years which can be portrayed that the farmers are adults within their productive age and therefore likely to use the technology. This is in line with [13] who indicated that enthusiasm to use new agricultural technologies is found in adult farmers who are within their productive age. The result showed that 79.8% of the farmers were married, 9.5% of the farmers were single, while 10.7% were widowed. This result suggests that the farmers are likely to be responsible adults. The results are similar with [14] that marriage gives farmers a huge sense of responsibility that inclines them into adopting new technologies for greater productivity that enables them provide for themselves and families. The result indicated that majority of the farmers 53.5% had attained secondary school certificate, followed by 21.8% who had primary education. The least proportion of the farmers (9.5%) had no formal education. In regard to the results, majority of the farmers could be said to be literate and more likely to use the rice-fish farming technologies as opined by [15]. The result indicated that 56.8% of the farmers had 5-9 persons living under the same roof, followed by 26.3% of the farmers who had less than 5 persons in their household. The mean household size of the farmers was 6, which indicated that the farmers maintained a moderate household size. [16] posited that moderate household size unburdens the farmer from some economic pressure that restrains them from engaging in productive farming. On membership of social organization, 74.1% indicated that they belonged to one social organization or the other as found by [17] that being members of social organization or the other exposes farmers to sources of information and knowledge as they interact with others in same or similar farming activities. The result indicated that 28.3% of the farmers had 1.7 - 2.2 hectares, 27.5% of the farmers had 0.5 - 1.0 hectares of farmland. The mean farm size of the farmers was 1.7 hectare which characterized the farmers as small scale farmers. Corroborating this, [18] stated that while farmers in Northern part of Nigeria are endowed with large farmland, farmers in the South-east are usually constrained by land fragmentation into less than five hectares farm size. The result further showed that 65.0% of the farmers had been into farming for 30-39 years, while 14.8% of the farmers had put in 10-19 years into farming. The average farming experience of the farmers

Table 2. Distribution of integrated rice-fish farmers by socio-demographic characteristics (n = 243)

Variables	Frequency	Percentage	Mean standard deviation
Sex			
Male	165	68.0	
Female	78	32.0	
	243	100	
Age(Years)			
16-25	28	12.0	±18.8
26-35	42	17.2	47 years
36-45	50	21.0	
46-55	59	24.2	
56-65	34	14.0	
66 and above	30	12.3	
	243	100	
Marital status			
Married	194	79.8	
Single	23	9.5	
Widowed	26	10.7	
	243	100	
Educational status			
No formal education	23	9.50	
Primary education	54	21.80	
Secondary education	130	53.50	
Tertiary education	36	14.80	
	243	100	
Household size			
1- 5	64	26.3	
6-10	138	56.8	6 persons
11-15	26	10.7	
16- 20	15	6.2	
	243	100	
Social organization Membership			
Members of social organizations	180	74.1	

Variables	Frequency	Percentage	Mean standard deviation
Non members of social organization	63	25.9	
	243	100	
Farm size (hectare)			
0.5 -1.0	66	27.5	
1.1 - 1.6	39	16.3	
1.7 - 2.2	68	28.3	
2.3 – 2.8	36	15.0	1.7
2.9 – 3.4	20	8.3	
3.5 – 4.0	9	3.8	
4.1 and above	5	1.0	
	243	100	
Farming experience			
1-10	68	28.1	
11-20	92	37.9	24years
21-30	62	25.5	
31-40	21	8.6	
	243	100	
Average Monthly income(#)			
1,000 - 10,000	28	11.5	
11,000 – 20,000	160	65.8	
21,000 - 30,000	14	6.0	18,840
31,000 – 40,000	16	7.0	
41,000 – 50,000	13	5.3	
51,000 – 60,000	6	2.5	
61,000 and above	6	2.5	
	243	100	

Table 3. Distribution of respondents according to availability of Rice-fish farming technologies in the area

Technologies	Frequency	Percentage
Use of terracing	80	32.92
Construction of trenches	50	20.58
Use of bamboo guard	70	28.81
Use of net guard	100	41.15
Stocking of Tilapia fish	98	40.33
Stocking of carp fish	191	78.60
Use of pests and disease resistant varieties	180	74.07
Use of organic fertilizer	150	61.73
Skills in harvesting of rice before fish, Skills in harvesting of fish before rice	130	53.50
	90	37.04
Transplanting of rice seedlings.	170	69.96

* Multiple responses

was 28 years which suggests farmers with considerable knowledge and skills. This confirms the view of [19] which perceived farmers as adults with substantial knowledge and skill in farming business. Majority (65.8%) of the farmers were earning N11,000 – 20,000 monthly, followed by 11.5% who earned less than N11,000 per month. The mean monthly income of the farmers was N18, 840 indicating that the farmers lived within the national minimum wage of N18,000. [13] agreed with this result when he posited that through complementary livelihood activities engaged in by farmers, the monthly income of farmers has been competitive with the national minimum wage.

3.2 Availability of Integrated Rice-fish Farming Technologies

Table 3 is the distribution of rice-fish farmers according to availability of integrated rice-fish farming technologies. The result revealed that stocking of carp fish (78.60%), use of pests and disease resistant varieties (74.07%), 61.73% use of organic fertilizer followed by transplanting of rice seedlings (69.96%) and skills in harvesting of rice before fish (53.50%) are the technologies perceived by the farmers as being most available in the area. Stocking of Carp will involve some specific technological requirements like ensuring that the rice seedlings are planted and allowed to mature before stocking [20]. There is introduction of netting to avoid predatory animals. To minimize post-stocking mortality fingerlings should be slowly and gradually acclimatized to the environment. These activities may translate to a low Cost: benefit ratio. This result supports the finding of [20] who in his report on fisheries in Nigeria stated that Carp fish varieties are among

the few varieties available to the farmers who cultivate rice and fish in the same portion. He added that skills in harvesting of fish before rice, the use of organic fertilizer, pests and disease resistant varieties are also characterized as the farm activities of such farmers. Meanwhile, where available rice-fish technologies are not accessible to the farmers, the benefits of such technology become elusive to the farmers [18]. The implication implies that government and extension organizations must ensure that farmers are assisted to use available technologies.

4. CONCLUSION

This Study has demonstrated that:

- The majority (68.0%) of the farmers were male while 32.0% were female farmers.
- The highest level of education attained by majority of the farmers was Secondary.
- The Technology that was most available to the farmers was stocking of carp fish.

5. RECOMMENDATIONS

- Female farmers should be encouraged to participate actively in agricultural cooperative meetings.
- To compensate for low Cost: benefit ratio, rice- fishing technology should be given a greater awareness and wide popularization through programmes like radio farmers, distribution of bulletins, flyers, mobile phones and attendance of agricultural cooperative activities.

- Government and extension organizations must ensure that farmers are assisted in the use of available technology.
- Extension agents should mount more aggressive awareness campaign in the area to encourage more farmers embrace the practice of rice- fish farming in the state.

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CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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