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Fish Culture in Rice Fields in IGBARIAM, ANAMBRA State, SOUTH EASTERN NIGERIA

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ABSTRACT :- A study to evaluate the profitability, acceptance and adoption of rice-fish farming in rice paddy fields in Igbariam Anambra State, Southeastern Nigeria, was carried out for a period of 56 week. A suitable site measuring one hectare was selected for the study in collaboration with a rice farmer. The land area was cleared, mapped out and divided into two experimental plots, each measuring 500m^2 after leveling, tilling and constructing the banks of the rice paddies and installation of water control measures. There were two treatments namely T_1 (sole rice plot) and T_2 (rice – fish plot). The experimental fishes were fed 5% of their body weight twice daily (8.00am and 6.00pm). The rice in T_1 and T_2 were routinely fertilized with 80kg of NPK fertilizer (40kg per application). Water quality parameters were routinely monitored. A total of 230kg (0.23ml) of rice was realized from T_1 giving a gross revenues of N67,500 and a net revenue of N52,500. In T_2, 300kg (0.30mt) of rice and 350kg (0.35mt) of fish were realized giving gross revenue of N82,500 and N199,500 from rice and fish respectively. Net revenue accruing from rice and fish in T_2 were N62,500 and N150,500 respectively. The rice-fish plot yielded more profit than the sole Rice plot. In addition T_2 provided a source of first class animal protein for food, better nutrition, health and additional income.

Key words: Rice-fish farming, Igbariam rice fields.

I. INTRODUCTION

Global recognition and interest in the potential of rice-fish farming in helping combating malnutrition has been well known for a long time (Li, 1992; Cai and Wang, 1995; Cai *et al*., 1995). The FAO Rice Committee recognized the importance of fish culture in rice fields back in 1984 (FAO, 1957; 2000; 2001), however, international interest gradually waned over the years perhaps due to the use of chemical pesticides and herbicides in the early attempts to boost rice productivity. It was not until the late 1980s when global interest in rice-fish farming was renewed.

A wide range of fish species have been tested in rice fields, including the cichlide *Oreochromis niloticus*, commong carp *Cyprinus carpio* and major Indian carp such as *Catla (Catla catla) Mrigal Cirrhinus mrigala*) and *(Rohu (Labeo ruita*). Other fish species that have shown good results and are of high acceptability in Asia and China include Chinese carps like the silver carp (*Ctenopharyngodon idella*), fresh water prawn, etc. (Fernando *et al*., 1979; Fedoruk and Leelapatra, 1992; Ghosh, 1992; Fernando, 1993; IRRI, 1993; Gregory and Gutatman, 1996; Greenland, 1997; Gupta, 1998; Halwart, 1998 and 2003).

There is very little attention being given to rice-fish culture here in Nigeria (Nwadukwe *et al*., 2006). This, therefore, forms the main thrust of the present research work which among reasons include the following.

- To introduce integrated rice-fish farming to conventional low land rice farmers in the state and country to complement irrigated agriculture.
- To demonstrate that this combination is more lucrative to the farmer by diversifying their productive capacity and sources of income.
- To provide the farmer with protein for food, better nutrition and health and additional income.
- To generate reliable data for planning and decision making

The integrated approach is in line with national and state agricultural policies and currently receiving Federal Government and FAO financial and technical support. There is also a vibrant domestic market for the rice and fish produced. Furthermore, the demonstration of the profitability of rice-fish culture has the potential of attracting more people to farming, thus reducing rural-urban migration (Nwadukwe *et al*., 2006). The ecological factors of this geo-ecological zone also allows the sustainability of rice cum fish farming.

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II. MATERIALS AND METHODS

A. Site Selection

The methodology for the present on farm adaptive research trial (OFAR) was carried out according to FAO, 2000; FAO/ICLAM/IIRR, 2001 and Nwadukwe *et al*., 2006. A suitable site measuring one hectare was selected at Ogboji for the research work in collaboration with a rice farmer who provided land for the research work. Igbariam is a town in Anambra State. Southeastern Nigeria. Anambra State lies within the following geographical locations: 5°45'N to 6°45'N and 6°N 36'E to 7°08'. It is bordered on the west by Delta State, on the North by Kogi State; on the east by Enugu State and in the South by Imo State.

B. Land Preparation

The selected area of land was cleared and mapped out and divided into two experimental plots each measuring 500m^2 after leveling, tilling and constructing the banks of the rice paddies and installation of water control measures. There were two treatments namely

(1) Sole rice (T_1)
(2) Rice-fish (T_2)

Construction of the pits (sumps) and canal.

In the Rice-Fish plot, a canal measuring 1 metre (m) deep and 0.5m wide was dug along the periphery of the paddy field in addition to a central line of canal traversing the rice paddy at pit (sump) measuring 30m long, 2m wide and 1.5m deep linking was also dug in the rice paddy (T_2) giving a total canal and pit area of 159m^2.
A total of 431.25 kg of agricultural lime was applied to the pit and canal in the rice-fish plot (T_2). Six hundred and twenty five kilograms of poultry droppings was also applied to the rice-fish plot after a waiting period of 2 weeks to serve as fertilizer to generate plankton and increase productivity.

C. Preparation of rice Nursery and Transplanting of Rice
A rice variety (Farrow 52) nursery was prepared, and the rice transplanted to the sole rice plot (T_1) and rice-fish plot (T_2).

D. Introducing of Fish Fingerlings
Six thousand fingerlings of *Oreochromis niloticus* with a mean length of 5.00cm±0.01 were introduced into the rice-fish plot. Three thousand post fingerlings of *Heterobranchus bidorsalis* (Geoggrey St. Hilaire 1809) with a mean weight of 9.50g±0.20 and mean length of 10.00cm±0.05 were later introduced into the rice-fish plot after a waiting period of 30 days.
The experimental fishes were fed 5% of their body weight two times daily (8.00am and 6.00pm) throughout the duration of the research work.
The rice in T_1 and T_2 were routinely fertilized using 80kg of N.P.K. fertilizer (40kg per application.

E. Water Quality Parameters

The underlisted physico-chemical parameters were routinely measured and monitored.

- Dissolved oxygen
- pH
- NH_3
- Alkalinity
- Temperature
- Transparency

F. Results

The mean values of physic-chemical parameters measured are presented in Table 1

Table 1: Mean values of physico-chemical parameters

S/no	Physico-chemical parameter	MIN	MAX	MEAN
1	Dissolved oxygen (mg/l)	5.80	7.50	6.65±0.50
2	pH	6.50	9.00	7.75±0.02
3	NH_3	1.20	2.05	1.25±0.01
4	Alkalinity (mg/l)	9.50	11.50	10.50±0.01
5	Temperature (°C)	25.00	28.00	26.00±0.50
6	Transparency (cm)	55.00	65.00	60±0.05

Mean values of physico-chemical parameters recorded fell within acceptable limits (Boyd, 1979 and 1982).

G. Rice Yield
A total of 230kg (0.25mt) of rice was realized from T_1 (sole rice) giving gross revenue of N67,500 and a net revenue of N52,500 (Table 2).

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In T_2 (Rice-fish plot) a total of 300kg (0.30mt) of rice and 350kg (0.35mt) of fish were realized giving a gross revenue of N82,500 and N199,500 from rice fish respectively. Thus net revenue accruing from Rice and Fish in T_2 were N62,500 and 150,500 respectively (Table 2).

H. Cost Benefit Analysis

A single cost-benefit analysis showed that a net profit of N52,500 was realized from T_1 while N212,500 was realized from T_2. Thus, the Rice-Fish plot yielded more profit than the sole rice plot.

The gross revenue from fish in T_2 was ₦199,500 less working capital of N49,000 giving a recovery rate of 75.20%.

Table 2: Cost-Benefit Analysis of Sole Rice (T_1) and Rice-Fish (T_2)

S/no	Item	T_1(Sole rice)	T_2(Rice-Fish)
1	Gross revenue from rice	67,500	82,500
2	Input and labour (Rice)	15,000	20,000
3	Net revenue from Rice	52, 500	62,500
4	Gross revenue from fish	-	199,500
5	Input and labour (Fish)	-	49,500
6	Net revenue from fish	-	150,500
7	Total net revenue	52,500	212,000

III. DISCUSSION

The mean values of the physico-chemical parameters measured during the course of the present study fell within limit prescribed by Boyd (1979) and Cagauan *et al.* (1993 and 1995). The higher rice yield 0.55metric tonne) in the Rice-Fish plot; 0.40 metric tonne of fish and the high recovery rate of 75.20% may have resulted in part from rice-fish interactions (Cagauan *et al*., 1993; Simpson, 1994; Cagauan *et al*., 1995; Mackay, 1995; Roger, 1996 and Nwadukwe *et al*., 2006).

Work done elsewhere (Boyd, 1982 and Simpson, 1994) have demonstrated the dynamics and equilibrium that exist on the one hand and the impact of other components such as, aquatic fauna on the Rice-Field ecosystem on the other hand with regard to nutrient recycling (Tokrishna, 1995).

Among the organisms that constitute the aquatic fauna in Rice fields, the benthic oligochaetes (for example *Tubifix cidae*) have been known to be capable of moving the reduced soil which lies beneath the shallow oxidized layer and the flood water. According to Simpson in Akukwe (2014) the oligochaetes together with ostracodis and dipteran larvae respond positively to nitrogen fertilizers if applied by broad casting. These findings agree with the results of the present study which incorporated the use of poultry droppings by broadcasting.

According to Cagauan (1995) fish plays an important role in nutrient recycle of the rice field ecosystem by influencing the nutrient composition of the flood water and the oxidized

surface soil as well as the growth of the rice plant. First by contributing more nutrients to the rice field through faeces excretion and as well as through decomposition of dead dish; by release of fixed nutrients from soil to water when the fish swim, by making the soil more porous and finally by assisting the recycling of nutrients when they graze on the photosynthetic biomass and other components of the ecosystem. These observations agree with the findings of the present study.

Other workers (Cagauna *et al*., 1993; Ali, 1998; Chen *et al*., 1995; Akukwe, 2014) have elucidated the interactions between fish and rice on the one hand and how fish affect the phosphorus cycle on the other. Fish have also been found capable of affecting the nitrogen cycle in a rice field Cagaunan *et al.* (1993) found that a rice field with fish has a higher capacity to produce and capture nitrogen than one without fish. This further corroborates the findings of the present study which showed that the rice-field plot produced a higher rice yield than the sole rice plot.

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IV. CONCLUSION

Rice-Fish culture should be embraced for the following reasons

a. It produces additional source of food and income in the form of fish
b. It controls mollusks and insects which are harmful to rice
c. It reduces the risk of crop failure resulting from integration of rice and fish.
d. Control of weeds through continued flooding of the paddy and rooting activity of rice help to control weeds and
e. The stirring up of soil nutrients by fish thereby making same more available for the rice thus increasing rice production.

Rice-Fish farming offers great potential for food security and poverty alleviation in rural areas. Other important side effects include a cleaner and healthier rural environment and rural employment.

It is recommended that a multi-sectional integrated approach involving various governmental agencies and other state stake holders (both private non governmental agencies) in Agriculture be adopted to project rice-fish farm beyond the fringes of novelty and limited set of projects it is presently consigned to. In this regard fisheries agencies have an important role to play.

A. Farmers Reaction

The rice farmers who grow sole rice within the vicinity of the study were satisfied with the result obtained and the successful conduct of the study. The farmers further expressed their willingness to adopt the rice-fish production technology if they receive support and encouragement from the state government or relevant government agencies.

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