Adoption of Aquaculture Technology by Fish Farmers in Imo State of Nigeria

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Abstract

This paper evaluated the level of adoption of aquaculture technology extended to farmers in Imo State, Nigeria. To improve aquaculture practice in Nigeria, a technology package was developed and disseminated to farmers in the state. This package included ten practices that the farmers were supposed to adopt. Eighty–two respondents were randomly selected from the three zones of the state. Data were collected through structured interview schedule. The results showed that the level of adoption of the technology was low. Less than half of the respondents adopted the technology. After the construction of the ponds, which were usually not to specification, the farmers found it difficult to adopt the other recommendations, (e.g., pond maintenance, feeding, harvesting, and fish preservation). It was discovered that the farmers did not have adequate funds to maintain their small ponds and to purchase the necessary feed and other necessities for aquaculture. To increase the level of adoption of aquaculture technologies in Nigeria, it is necessary to change its perception from subsistence to commercial and sustainable farming practice; to assist the farmers with credit facilities and to provide closer monitoring of the process by extension agents.

Introduction

In Nigeria, fish production is not only important as a source of rich protein, but it also can be used to bring about institutional changes. These changes can offer access to production assets and resources, which can help to empower the poor and directly promote their livelihood (Obikezie, 1999). Unfortunately, Nigeria is not producing enough fish for consumption; also, the fish industry is not providing the much needed financial empowerment that the fish farmers need. According to the Food and Agriculture Organisation of the United Nations (FAO, 2006a) there is a huge supply demand gap for fish and fishery products in Nigeria. According to the report, there is about 400,000 tons of supply in comparison to the 800,000 tons of demand. This makes Nigeria one of the largest importers of fish in the developing world, importing 600,000 metric tons annually (Moehl, 2003). It is therefore necessary to ensure that improved fish production technologies that have been developed and disseminated are adopted, in order to increase fish production.

The fishery industry is crucial to the World economy. The livelihood of millions of people worldwide are dependent on fish farming (Greenfacts, 2004). Fish provides a rich source of protein for human consumption. The flesh of fish is also readily digestible and immediately utilizable by the human body, which makes it suitable and complementary for regions of the world with high carbohydrate diet, like Africa (FAO, 2005a). Research results have linked seafood consumption to reduced risk of disease. The U.S. Government has recommended that all Americans eat two seafood meals per week (Healthnews Digest, 2006). In 2002, the world's total fishery production was reported to be 133 million tons (Vannuccini, 2004).The production from world capture fisheries amounted to 93.2 million tons. This represents a slight increase of 0.4 percent compared with 2001, but a 2.4 percent decline from the peak of 95.5 million tons reached in 2002. About 74 percent of fish produced were used for direct human consumption (Vannuccini, 2004).

Globally, however evidence indicates that in many areas fishery management is failing (Cichrame, 2000). Though it has been geared toward full employment and social peace, the management of the fishery industry has not achieved this goal. According to FAO reports (2005b) the system is not operating in a sustainable and efficient manner. Over the years, however, efforts have been made to develop new technologies, which have been introduced to the industry. This has led to more fish being caught, but this has also resulted in the overexploitation of fisheries (MacLennan, 1995).

The global fisheries production data is not a true reflection of the development in some of the regions of the world. The Less Developing Countries (LDCs) have been experiencing serious decline in production in recent years. Per capita fish supply in the LDCs is still relatively low at an estimated 8.5kg in 2001 (industrialized

countries = 13.2 kg) (Greenfacts, 2004). In Africa, the fish sector provides income for over 10 million people engaged in fish production, processing and trade (New Partnership for African Development, 2005). Fish has also become a leading export commodity for Africa with an annual export value of $2.7 billion (U.S.). Yet these benefits are at risk as the exploitation of natural fish stocks is reaching its limits (Mutume, 2002). Although there is a paucity of information on the status of the fisheries industry, and the role it plays, it is estimated that Africa produced 7.3 million tons in 2003, and 4.8 million tons was from marine fisheries (FAO, 2003).

Aquaculture is the breeding and rearing of fish, shellfish, or plants in ponds, or any enclosure for direct harvest of the product. It has come to greatly augment the dwindling marine fish production worldwide, and this field is growing rapidly (Muir & Nugent, 1995; FAO, 2004). Data from Greenfacts (2004) has shown that aquaculture is the fastest-growing animal-based food production sector, particularly in the developing countries – mainly from China and other Asian countries. In Africa, the governments of the continent under the aegis of the African Union, have identified the great potential of aquaculture and are determined to encourage private sector investment (NEPAD, 2005). The potential exists for aquaculture to make a difference as shown by pilot projects, although these pilot projects fail when they are scaled up (Newagriculturists, 2005). While capture fisheries production has stagnated throughout the African continent at about 8 kg per person, aquaculture-based consumption has continually increased from 50 gm per person in 1984 to 100 gm per person in 1992. However, this is still 1.3 percent of total fish intake (Bardach, 1997).

Nigeria has over 14 million hectares of inland water surface, out of which about 1.75 million are available and suitable for aquaculture (FAO, 2006b). In Nigeria, aquaculture is predominantly an extensive land based system, practiced at subsistence levels in fresh waters (Anyawu-Akeredolu, 2005). Commercial farming has yet to become widespread (Fagbenro, 2005). At present, most fish farmers operate small-scale farms ranging from homestead concrete ponds (25-40 metres) to small earthen ponds (0.02-0.2 hectares). The industry produced over 30,000 tons of fish in 2000 (FAO, 2005c).

The development of aquaculture can only be enhanced by the introduction of modern technologies. While there have been instances of successful introduction of technologies to boost production in Bangladesh (Thompson, Sultana, and Khan, 2005) and Ghana (World Fish Centre 2005), the major problem has been the lack of appropriate technology (Gupta, Bartley, & Acosta, 2004; Toure & Noor, 2001; UNDP, 2004a). Aquaculture technologies have been developed and disseminated to farmers. While some scholars have stated that what is needed is to develop the technologies and make them available (Joshua & Omidiji, 2002), others insist that the transfer of technology would be more effective when there is a greater interaction among the developers, transfer agencies, and the farmers (Dlamini 2003; Yap-Gnaore, Ehui, & Shapiro, 1995). However, the crucial point is for the farmers to be able to afford any technology extended to them. A UNDP Report (2004b) indicated that it was the inability of farmers to afford the technologies extended to them that made farmers abandon the ponds. Rogers (2003) has added another dimension by stating that the adoption of technology can be affected by the way it is named and positioned.

This paper evaluated the adoption of an aquaculture technology package extended to farmers in Imo State, Nigeria. The objective was to identify the level of adoption. This is necessary because public sector extension is seldom properly evaluated (Farrington, Christopolos, Kidd, & Bechman, 2002) and so often the level of performance of a particular technology introduced is usually unknown.

Methodology

Study Area.

Imo is one of the 36 states in Nigeria located in the southeastern part of the country. The land area is estimated at 5100.1 square km. The state lies within Latitude 5˚ - 6˚ North of the Equator and Longitude 6.5˚ and 7.5º East of the Greenwich meridian. Apart from Imo River and Oguta Lake, the state is blessed with many inland waters such as the Igwu, Otamiri, Nworie and Ogachi rivers (Iloeje, 1999). The population of the state stands at 2,485,499 according to the National Census of 1992. Generally, about 80 percent of the people engage in agriculture.

Extension services are fully funded by the State under the Agricultural Development

Project (ADP). The State is divided into three agricultural zones, namely Owerri, Orlu and Okigwe zones.The zones are further broken down into blocks. A block is an agricultural area covering a specified number of villages and supervised by extension agents. Again, each block is further divided into circles or cells. Each block contains eight circles. A circle is an agricultural area containing a number of farm families. Thus, the Owerri zone has 18 blocks and 144 circles; Orlu and Okigwe have 10 blocks and 80 circles each. In all, the State is made up of three zones, 38 blocks and 304 circles.

Data Collection

A total of eight blocks were randomly selected, four from Owerri and two each from Orlu and Okigwe zones, and two circles were also selected from each block. A comprehensive list of 520 fish farmers was obtained from the ADP and the village heads. Seven farmers were picked from each circle, resulting in a total of 112 respondents. However, only 82 of them were available for an interview, which was conducted using a structured interview schedule. Due to some educational and cultural considerations, trained enumerators were hired to interview the farmers and record their responses during the interview.

Aquaculture Technology

The technology that was disseminated to farmers was a 10-item package (see Table 1). It included information on pond-site selection, pond construction, pond installation, pond preparation, stocking of pond, transportation of fingerlings, feeding, pond maintenance, harvesting of fish, and fish preservation. For each item an action had to be taken, and each respondent was asked whether that action was taken. Every positive answer meant that the item was adopted. The cumulative positive responses of each respondent indicated the level of adoption. The total level of adoption was determined by calculating the percentage of the total positive responses. The personal and socio-cultural factors associated with the farmers were also studied.

Results and Discussion

Factors Associated with the Adoption of the Technology

It has been noted that people do not just adopt a technology because it is available to them. Even when the technology is available and appropriate, some personal and socio-cultural factors bear on the decision to adopt or not (Berdegue & Escobar, 2001; Daniel, Wilson, & Myers, 2005; Garforth, Angell, Archer, & Green, 2003; Perkin & Rehmand, 1994). In this study some of these socio-cultural factors were identified and studied (see Table 2).

Table1. Questions on the Adoption of Aquaculture Technology

Practice	Yes	No
Site selection Did you do any soil testing before selecting your site?		
Pond construction Is your pond constructed to the dimensions recommended by the ADP?		
Pond installation Did you install water inlet and outlet devices in your pond?		
Pond preparations Did you lime the pond before flooding with water?		
Pond stocking Do you stock the pond based only on the specifications by the ADP?		
Fingerling transportation Do you transport your fingerlings in plastic bags alone?		
Fish feeding Do you feed the fish according to ADP recommendations alone?		
Pond maintenance Do you check the walls of the pond quarterly?		
Harvesting Do you restrict the harvesting to the time recommended by ADP only?		
Preservation Do you use the chilled holding recommended by the ADP?		

From Table 2, 73 percent of the respondents were male. In most cases, fishing activities were done by men, though women are more engaged in the processing and marketing areas. Given the cultural life of most rural African communities, women are still largely kept in the background. So when studies are being conducted, men (usually husbands) are most likely to answer for women (wives). This becomes prevalent because in most communities almost every adult female is likely to be married. This is verified from the result in this study. Almost all the respondents (93%) were married.

Table 2. Selected Personal and Socio-cultural Factors Associated with the Adoption of Aquaculture.

Factors Frequency (# = 82)		Percentage
Male respondents	60	73
Age (30-49)	46	56
Basic education	52	56
Married	76	93
Fulltime farming	27	33
Access to demonstration	62	76
Utilized demonstration	24	29
Popularity of practice	5	6
Community restriction	42	51
Cultural inhibition	79	96

The mean age of the sampled group was 34 years. More than half of the respondents (56%) were between the ages of 30 and 49. This indicated that the respondents were relatively young. The mean age of farmers in Nigeria is usually between 45-48 years (Ezedinma & Otti, 2001; Ogunwale, 2000). The reason for this age composition is easily explainable since aquaculture is relatively new in the country, and there was the deliberate intention by the ADP to target younger farmers who are likely to be interested in homestead fish farming. The results also showed that the respondents were well educated. About two-thirds of them had received a basic education, (i.e., attending twelve years of formal education). Only 3 percent of them did not attend any formal school. This level of education should encourage the adoption of the technology.

Only 33 percent of the respondents were full-time farmers. The rest were artisans, civil servants, business people, and others. Again, this reiterates the fact that the technology was targeted at younger and more educated members of the community. The objective was to introduce aquaculture as a hobby that one can add on to one's other vocation. Hence, the technology was introduced as a simple and subsistence farming rather than a commercial farming venture. Some scientists blame this faulty approach for the failure of aquaculture practice (Fagbenro, 2005).

In introducing aquaculture to the farmers, the extension agency established demonstration farms to teach them. This study found that a vast majority of the respondents (76%) had access to the demonstration farms. However, only about a quarter of the respondents (29%) utilized them by attending the demonstrations (Table 2). The result of this study also showed that aquaculture was not yet a popular vocation. However, there was no cultural inhibition or restriction on land use against the practice.

What can be deduced from these results is that the personal and socio-cultural characteristics of the respondents were favourably disposed to the adoption of the innovation. It was introduced at the homestead, simply, as an activity that would bring additional income to the household.

Adoption of Aquaculture Technology

Results from Table 3 show that the total level of adoption of the technology was 41 percent. Out of the ten components of the technology, about half of the respondents adopted pond construction practice (54%) and pond installation (51%) respectively. Also, 50 percent of them adopted the recommended transportation practice of fingerlings, but only 27 percent of them adopted the proper site selection. However, less than 50 percent of the farmers adopted other practices like pond preparation (44%) feeding (47%) pond maintenance (44%) and stocking practice (34%). In contrast, although 39 percent adopted harvesting practice, only 19 percent of them adopted the preservation practices.

Table 3. Distribution of Respondents According to Percentage Adoption of Technology.

Practice Frequency (# = 82)		Percentage
Site selection	22	27
Pond construction	44	54
Pond installation	42	51
Pond preparation	36	44
Stocking	28	34
Transportation	41	50
Feeding	39	47
Maintenance	36	44
Harvesting	32	39
Preservation	16	19

Level of adoption # = 41 percent

The recommended practices could be categorized into three groups (i.e., pond construction, raising the fish to maturity, and the processing of the harvest). From the result, it could be seen that the adoption level descended from the first to the last group. From the data, half of the respondents adopted the pond construction, which also included installation, preparation, and stocking. Here the adoption of the site selection recommendation was low, and that is understandable. The technology materials recommended that a proper site should be selected in terms of choosing appropriate topography with perennial source of water, and ensuring good quality of soil through soil analysis. However Imo State is very densely populated, so there is more pressure on land availability. Farmers are forced to choose any available land, and they do not even have the financial resources to carry out the tests required for water and soil analyses. It will be assumed that the construction of the pond received the highest adoption score for obvious reasons. Construction of a pond is the necessary first thing to do. At this point, the extension agents, eager to get people to adopt the innovation, provided the highest level of supervision. With the promise of more incentives, farmers were likely to construct the ponds.

After the construction of the ponds, however all other practices to raise the fish were not fully adopted. The exception here was the transportation of the fingerlings where 50 percent of them adopted it. Again, this was not surprising because transportation of fingerlings is the most delicate aspect of aquaculture (Gertjan & Janssen, 1996) and sometimes only 5 percent of the fingerlings survive due to inappropriate handling (Brown & Laland, 2001). Feeding and maintenance of the pond were adopted by less than half of the respondents. It could be assumed that at this point, farmers receive less supervision from the extension agents. After they helped with the construction and stocking of the pond, the agents would assume that the farmers would practice the other recommendations. Feeding was always a problem because farmers were not always able to afford the cost of the feed and to devote themselves to required feeding regime. This could be due to sudden change in the price of feed as a result of inflation. Sometimes, the feed would not even be available in the market. Due to the low quality of locally produced fish feed, farmers often depended on imported feed. However, these are more expensive and may be scarce because of import policies.

Harvesting and processing practice received the lowest level of adoption. About 39 percent of the respondents adopted the harvesting practice. It was discovered that since the technology was introduced as subsistence farming, the farmers found it convenient to harvest the fish at will rather than waiting for the appropriate time. Less than a quarter of the farmers adopted the preservation practice. Since this practice entailed procuring other equipment, not many resource-poor farmers could afford the extra cost of equipment. Since the harvest was very poor, due to the small farm size, there was hardly any need to preserve the fish since they were usually consumed at harvest.

Conclusion

Results from this study showed that the level of adoption of aquaculture technology in the Imo State of Nigeria was low. Many of the farmers who were supposed to be engaged in aquaculture had abandoned it. Important components of the technology that had to do with raising and processing the fish at harvest were adopted by few of the respondents.

The major reason for the low adoption of the technology was the poor economy, which raised the rate of inflation. The farmers continued to experience dwindling disposable income that could be ploughed into the farm. A corollary to this was the inconsistency of some of the Government's policies. There were usually policy changes regarding the importation of feed. When the feed was not available, the fish would die, and the farmers would abandon the ponds.

It can also be inferred that the initial policy of the extension agents to introduce aquaculture as subsistence farming was wrong. When people do not see a technology as generating income immediately, the motivation to commit resources to the venture will not be there. Of course, this was the reason why the technology was targeted at those who already had other sources of income. It therefore means that the poor economy is affecting every sector in the country. For aquaculture in Imo State, therefore, it became a vicious circle. The farm size was too small to generate enough income to sustain the farm.

To improve aquaculture in the State and in Nigeria, the practice should be reintroduced as a commercial venture that could generate income and become sustainable. It also means that the Government must identify genuine investors in the business who are ready to go into the venture full time, and provide adequate financial credit for them.

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