COSTS AND RETURNS ANALYSIS OF ARTISANAL FISH FARMING (LATES) IN KEDETIFIN DISTRICT OF MOKWA LOCAL GOVERNMENT AREA OF NIGER STATE, NIGERIA.

Ndanitsa, M.A[1]; Umar, I.S[1]; Mohammed, U.S[1]; Sani, T.P.[1].' and Ndako, N[2]
1. Department of Agricultural Economics and Extension Technology, Federal University of Technology, Minna, Niger State, Nigeria.
2. Department of Geography, School of Arts and Social Sciences, Niger State College of Education, Minna, Niger State, Nigeria.
Corresponding Author: E-mail:attahirundanitsa@yahoo. G.S.M: 08036475750.

ABSTRACT
The paper examined the profitability of small scale fish farming sub-sector, by determining the cost and returns in artisanal fish farming in Kede-Tifin district of Mokwa Local Government Area of Niger State, Nigeria. Primary data were collected for the study with the aid of structured questionnaires. Multi-stage sampling technique was used to draw samples for the study. The first stage involves the purposive sampling of Kede-Tifin district of the state, as fishing is the principal occupation of more than 90 percent of the inhabitants of the area. The second stage involves the selection of 5 fishing communities, followed by selection of 4 fishing locations, and finally the selection of 12 fish farmers from the 20 fishing localities to give a sample size of 240 respondents. However, only 198 respondents were used for the analysis, due to incomplete information and non-response. The result of analysis of the study showed that Average fixed cost (AFC) and Average Variable Costs(AVC) were ₦116,005.14/fish farmer/year and ₦181,877.56/fish farmer/year respectively. Fishing crafts and gears accounted for 35.16% of total cost of production, while labour input cost, fuel/lubrication and repair of equipment made up to 46.92% of total costs of production. While Net Margin/fish farmer/year was ₦111,677.62 for the study area, it was ₦140.74 among creator/pump machine units and ₦84,012.15 for fish farmers in the non-aerator/pump machine segments. Net Margin to cost ratio was 34% in the aerator/pump machine sector, 45% in the non-aerator/pump machine segment, and 37% for the entire area studied. Return-on-sales were 25%, 31% and 27% respectively amongst aerator units, non-aerator units and entire area of study. Results of regression analysis showed that demographic and economic variables such as households size, gender of respondents, labour and non-fish farming income significantly determine (P<0.05) fish output in consonance with a priori expectations. While the elasticity of fish harvested (output) with respect to labour utilization was strong and positive, it was negative for non-fish farming income. Furthermore, constraints to fish farming in the study area include, inadequate capital, lack of access road, high transportation cost, lack of preservation and processing facilities etc, it was therefore concluded that though, fish farming in the study area is profitable, but can be made more lucrative if the identified problems can be adequately addressed in the study area.
Key words: Small-scale fish farming, profitability ratios, Kede, Output Elasticity.

Introduction

Lates, especially *Lates niloticus* belongs to the family *centropomidea*, comprises one of the most commonly cultivated fishes in Nigeria. The growth of aquaculture in Nigeria now is largely being boosted by a steady rise in *lates* and catfish culture, since the multiplication of fish through hypophysation (a breeding technique) was initiated in Western Nigeria in 1973, the procedure has been widely practiced throughout Nigeria, thus leading to increase of farm-raise *lates* fishes from the COs to date (Ndanitsa, 1994). *Lates niloticus* is the biggest freshwater fish in Africa. In Nigeria, it is found in Lake chad, Kainji Lake, River Niger and River Benue, and some other large swamps and rivers. It's Hausa name is "*Giwan ruwa*" meaning "the Elephant of the sea". It is the famous Nile perch in Niger perch, a verile giant among fresh water fish and it grows up to the truly magnificent size of about 80kg (Ndanitsa, 1994).

Over 90 percent of the 38 million people recorded as fishers (Fishermen and fish farmers) are classified as small-scale. This is in addition to more than 100 million people who are estimated to be involved in small-scale post-harvest activities such as processing and preservation (Bene *etal*; 2007). According to FAO (2004), small-scale fisheries can be broadly characterized as dynamic and evolving

sector of the economy, employing labour intensive mode of production, harvesting, processing and distribution technologies to exploit marine and inland water fishery resources. The activities of this sub-sector, conducted full time or part-time or just seasonally, are often targeted on supplying fish and other aquatic resources to local and domestic markets, and for subsistence consumption. Export-oriented production, however, has increased in many small-scale fisheries during the last one or two decades because of greater market integration, marketing prospect and economic globalization. More often than not, while typically, men are engaged in fishing/fish farming and women in fish processing/preservation and marketing, women are also engaged in near shore harvesting activities and men are known to engage in fish farming, marketing and distribution. Other ancillary activities such as net-marketing, boat building, engine repair and maintenance can provide additional fishery-related employment and income opportunities in marine and inland fishing communities. Generally, small-scale fisheries operate at widely differing organizational levels, ranging from self-employed single operators through informal micro-enterprises to formal sector businesses (Bene *etal*; 2007). Aquaculture is the rearing of growing fin fish and shell fish under controlled condition (Ayodele and Fragene, 2003). It is also the rearing of aquatic organisms under controlled or semi-controlled condition (such as shrimps, minnow, Gold fish for stocking into farm ponds, streams, reservoirs, oceans and growth of aquatic plants like algae) for economic and social benefits (Ayodele and Fragene, 2003).

Fish farming like any other hunting activities has been a major source of food for human race and has put an end to the unsavory outbreak of anaemia and other nutritional diseases. It accounts for about one-fifth of the world supply of animal protein and this has risen five-folds over the last four years from 20 million metric tones to 98 million metric tones in 1993, and projected to exceed 150 million metric tones by the year 2013 (FAO, 1991). This is profitably achieved through; increasing the area of fish ponds and facilities of other aquaculture methods such as cages, raceways and reservoirs as well as increasing the production per unit area of the existing aquaculture facilities (Bardach *etal;* 1972). According to Hishamunda and Kidler (2004), and indeed fish production share of world food supply has grown 7 percent of world tonnage in 1973 to 12 percent in 1985, and to more than 30 percent. Aquaculture baseline forecast suggest that, it will account for 40 percent of food fish industry, but it could be higher and exceed 50 percent (Delgado *etal;* 2003).

Fish are able to convert their feed into flesh about two times more efficiently than chicken and 5 to 10 times more efficiently than beef. The feed conversion rates of fish are higher than other common commercial animal protein sources, and fish products can compete favourably in terms of price with chicken; the size of fish consume public will remain relatively low (Helfrich and Garling, 1997). Fish culture, especially *Lates,* therefore, has the potential of contributing annually about 636,820 tones or more to the domestic production. Nigeria has become one of the largest importers of fish in developing world despite its huge aquatic resources, importing up to 600,000 metric tones annually (FAO,2004). In Kede-Tifin district of Mokwa Local Government Area (LGA) of Niger State, Nigeria, Artisanal fish production is a major vocation in the riverine areas, and it makes significant contribution to the livelihood of fishing communities by supplying food, generate income and employment opportunities and source of protein to man. Between 2001 and 2010, artisanal fish production ranged from 7.369 to 16.876 metric tones in the LGA (NSMLF; 2010), and the intense fishing pressure and frequent incidence of use of pesticides in the area are implicated for the low level of production/catches.

Moreover, effort towards the production of fish like *lates* must not be limited to its biological aspects alone, but the economic aspect must be conducted on the input-output level with a view to assessing the profitability and socio-economic factors affecting its production, then proffer solution and useful recommendations. Furthermore, other limitations to the achievement of the goals of self-sufficiency in fish production include lack of finance and high investment cost of *lates* farming, high interest rate and availability of lending capital. With respect to the problems highlighted, the following questions emanates, which the study tries to provide answers to: what are the socio-economic characteristics of the *lates* fish farmers that influence their fishery activities? What types and levels of inputs are used in lates farming? What is the elasticity of production

and the resource-use efficiency? And what problems are encountered by *lates* fish farmers in the area? The objectives of this study, therefore, was to consider the performance of artisanal fish culture (*lates*) by examining the socio-economic characteristics of fish farmers, examine the type of inputs employed by the fish farmers, determine the cost and returns as well as profitability of artisanal fish farming, determine the elasticity of production and resources use efficiency by artisanal fish farmers and identify factors that affect output in small-scale fish farming in the area.

METHODOLOGY

Study Area

This research was conducted in Kede-Tifin District of Mokwa LGA of Niger State, Nigeria. Wuya Kede is the district headquarters, while Mokwa is the LGA headquarters. The LGA has a population of 242,858 people (N.P.C; 2006). This study however, was restricted to Kede-Tifin district, which is made up of the following eight (8) fishing communities (commonly known as fishing village areas), namely Wuya Kede, Ketso, Kpambo, Kphachita, Yidzunwungi, Wuchi, Ja'agi and Dutsun.

Sampling Technique and Method of Data Collection

Multi-stage sampling procedure was used to draw samples for the study. The first stage involves purposive sampling of Kede-Tifin district of the state, as fishing is the principal occupation of more than 90 percent of the inhabitants of the area. The second stage involves the selection of 5 fishing communities, followed by selection of 4 fishing locations, and finally the selection of 12 fish farmers from the 20 fishing localities to give a sample size of 240 respondents. However, only 198 respondents were used for the analysis, due to incomplete information and non-response.

Primary data were collected for the study with the aid of questionnaires. Data collection included information on socio-economic characteristics, production data (on feeds, fertilizer, fingerlings, fishing gears, labour, sales and revenue) and infrastructure and membership of local groups and cooperative societies were also obtained. The survey was conducted between March, 2009 and February, 2010 when fish farming activities were used to be at the peak.

Method of Data Analysis

Descriptive Statistics: Such as percentages, ratios, means/average, tabulations, frequency distribution etc were used to achieve some of the stated objectives.

Cost and Returns Analysis: This was used to determine the profitability/Net farm income of artisanal fish farming.

Production Function Model: This was achieved through regression analysis. The model was employed to determine the elasticity of production and resources-use efficiency by artisanal fish farmers.

Model specification and Estimation

The postulated econometric model shows that the volume of *Lates* fish reared in the area is determined by both social and economic variables, included in the model. The general model is of the form:

$Q = F(X_1, X_2, X_3 X_4, X_5, X_6, X_7, X_8, X_9, X_{10} X_{11}, U)$

Where Q is the quantity of fish reared (in kg), X_1 is level of formal educational attained by respondents coded as 1, no formal education; 2, primary school; 3, secondary school; 4, tertiary education (colleges of agriculture/education, polytechnics, universities; X_2 is household size of respondents; X_3 is fish farming experience, measured as number of years in fish farming ventures; X_4 is depreciation of capital inputs such as canoes/boats, gears, aerators, and accessories; X_5 is labour input measured as number of hours spent in fish farming activities per day (in man-days); X_6 is cost of fuel and lubricants; X_7 is non-fish farming income; X_8 is cost of feed, repairs and maintenance of gears and equipment/tools; X_9 is gender of respondents (Male=2, Female = 1); X_{10} is number of ponds; X_{11} is pond size and U is the stochastic error term.

However, different functional forms of the model were fitted to the data, but the logarithmic model had the best fit, and is specified below.

$\log Q = \log b_0 + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + b_8 \log X_8 + b_9 \log X_9 + b_{10} \log X_{10} + b_{11} \log X_{11} + U$ .....equation 1.

Where log Q -=Output of fish (in kg), b1, - b14 is coefficient of independent variables and X_1 – X_{11} is independent variable used to attain the output of fish, Q.

The logarithmic function is one of the most widely used in empirical studies, because the

regression coefficients are measures of direct elasticities (Olayemi, 1991; Almeida *etal*; 2001; Baba, 1989; Omotesho, 1991; Omotesho and Olawale, 1991 and Faseyi, 1994). Similarly, the ordinary least squares (OLS) technique was used to estimate the relevant parameters.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Artisanal Fish Farmers

The socio-economic characteristics of artisanal fish farmers of lates is presented in Table 1.

Table 1 shows that, although both men and women were actively involved in artisanal fish farming in the study area but men were more dominant in numbers. A number of socio-economic factors restricted access to water resources; low technical know-how and lack of credit facilities limit full participation of women in the small-scale fisheries sector (Williams, 2002). From the table, 77.3 percent of the fishers were males, while 22.7 percent were females.

Table 1: Distribution of socio-economic characteristics of Artisanal Lates Fish Farmers (n=198).

Parameter	Frequency	Mean (Mode)	Standard deviation	Minimum	Maximum
Gender:					
Male	153(77.3)	(Male)	0.500	0	1
Female	45(22.7)				
Household Size:					
4-6	35(17.7)				
7-9	65(32.8)				
10-12	53(26.8)	9 persons	2.95	3	17
13-15	38(19.2)				
16-18	7(3.5)				
Educational level:					
Non-formal education(1)	71(35.9)				
Primary school (2)	65(32.8)				
Secondary school (3)	48(24.2)	2.0	0.94	1	4
Tertiary education (4)	14(7.1)				
Fish farming experience (years)					
1-3	30(15.1)				
4-6	99(50)				
7-9	53(26.8)	6years	2.35	1	14
10-12	15(7.6)				
13-15	1(0.5)				
Labour input (Mondays)					
Trips/week:					
Twice	50(25.3)				
Thrice	75(37.9)				
Four times	67(33.8)	3.15	1.05	2	5
Five times	6(3.0)				
Age (Years)					
20-30	8(4.0)				
31-40	21(10.6)				
41-50	88(44.4)	37.53	15.63	3	11
51-60	63(31.8)				
Above 60	18(9.1)				
Marital Status:					
Single	29(14.6)				
Married	123(62.1)				
Widow(er)	15(7.6)	63	1.46	3	3
Divorce	23(11.6)				
Separated	8(4.0)				

- Source: Computed from field survey data, 2010
- Figure in parenthesis are respective percentages

A relatively large household size was found in the area with an average size of nine (9) persons per household, though 49.3 percent of the households have a family size ranging between 10 and 18 persons. Preponderance of large family sizes is a characteristic of the poor in rural areas (Eboh, 1995). Small-scale fish farming is highly labour-intensive, much of the labour is needed in post-harvest activities such as fish processing, distribution and marketing. Many fishers tend to have large family size since it is an important indicator of possible source of family labour.

Table 1 also revealed that 64 percent of the fish farmers producing *lates* had some form of formal education, while 36 percent did not. The mean level of educational attainment for all the fish farmers in the area sampled was primary education. Lack of education among members of the fishing communities in West Africa posed some constraint on sustainability in artisanal fisheries sub-sector.

The number of years spent in fish farming among the fisheries in the study area ranged between 1-14 years, with a mean experience of 6 years. Infact, 65 percent of the fish farmers rearing *lates* have practiced aquaculture for between 1 and 6 years, while 35 percent of them have been in the venture for 7 to 14 years (Table 1). The distribution indicates that fish farmers are relatively young in the business. Therefore, they require adequate experience or preliminary training in aquaculture, more so, a sizeable number of farmers learn by doing. According to Osuntogun (2000), several factors are known to affect the credit needs of farmers, prominent among these factors are due to their past experience

Table 2: Production Variables

Parameters	Frequency	Mean (Mode)	Standard deviation	Minimum	Maximum
Lates Fish Output(kg):					
158-873	75(37.9)				
874-1589	56(28.3)	1,391.51	932.29	158	4.450
1590-2305	34(17.2)				
2306-3021	18(9)				
3022-3737	8(4)				
3738-4453	7(3.5)				
Fish Farming Income/Year(N):					
(-83132.84-(-2916.80)	35(17.7)				
1280-82280	65(32.8)				
82281-163281	34(17.2)				
163282-244282	25(12.6)	111,677.62	129,665.04	831,132,284	405,33.90
244283-325283	18(9.1)				
325284-406284	21(10.6)				

- Source: Computed from field survey data, 2010
- Figure in parenthesis are respective percentages
- ₦ is the Nigerian currency, the Naira; ₦148.00 equals US$1.00

The number of hours/day/week spent by the fish farmer ranged from 2-15, with mean value of 3.15 Man-days per week. About 63 percent of the respondents spent 2 or 3 man-days per week, which is a characteristic of artisanal fishery activities. Table 1 also shows that majority of the fish farmers (44.4%) falls within the age brackets of 41-50 years. In general terms, however, the distribution shows that most of the fish farmers in the area (86.8%) were within the age brackets of 31-60 years, with a mean age of 37.53 years. The implication of this finding is that most of the fish farmers were within the economically active age of labour productivity and might likely utilize the credit obtained for productivity.

Majority of the fish farmers (62.1%) in the study area were married couples, and only 14.6% were single, and is an indication that the fish farmers in the sample were responsible people towards their household activities, including fish farming.

Production Levels.

Table 2 reveals the level of fish production from aquaculture, indicated by output of *lates* per fish farmer in the area. The output ranged between 158-4,453kg, with an average annual input of 1,391.5kg. Though the mean harvest is

somewhat low, it is also subject to great variability as shown by the standard deviation of 932.29. About 66 percent of the fish farmers had yearly fish harvest of 158-1,589 kg, while only 16.5 percent of them harvest fish ranging between 2,306.4-4,450kg per annum. The low level of fish output from the venture may be due to the continuous use of traditional methods of fisheries in the area, which has led to low and unstable level of income from artisanal fisheries. Furthermore, a great variability was also found in income from fish farming in the area. In fact, 35 fish farmers representing about 18 percent of the sampled fish farmers, had a net loss from fish farming, ranging between (₦83,132.84)-(₦2,916.80). Therefore, there is need to explore alternative income generating opportunities for fish farming enterprise giving the current level of resource exploitation (FAO, 2002).

Types of inputs Used by the Fish Farmers.

Fish farming is a capital intensive venture when considering the nature of resources required to start and sustain the business. A lot of resources are required for the purchase of inputs, including labour. The inputs utilized by the fishers in the study area is presented in table 3. Various types of labour are utilized by the fishers in the study area. Results of labour types in table 3 shows that most of the fishers (51.5%) utilize family labour, and this cannot be unconnected with the fact that most of the fish farmers were operating at small scale and were married with large family sizes that may be readily available for work in the farm.

Table 3: Distribution of respondents based on types of inputs utilized (n=198)

Type of inputs	Frequency	Percentage
Labour:		
Family	102	51.5
Hired	69	34.8
Communal	27	13.7
Pond:		
Earth pond	74	37.4
Flow-through	36	18.2
Re-circulatory	88	44.4
No. of fingerlings		
1-2,000	43	21.7
2001-4,000	56	28.3
4001,6000	41	20.7
6001-8000	32	16.2
8001-10,000	26	13.1
Quantity of feeds (kg)		
1-500	2	1.0
501-1000	7	44
1001-1500	63	31.8
1,501 - 2000	39	19.7
2001-2500	7	3.5

Source: Field survey data, 2010.

Fish farmers make use of different types of ponds, depending on their choice and convenience. However, some (44.4%) of the farmers make use of circulatory type of pond, which they say is costlier than the earthen pond but is more durable and dependable, especially in its ability to hold large volume of water and withstand turbidity and salinity. Meanwhile, the minimum stocking capacity of 1,200 fingerlings is carried out by 21.7percent of the sampled respondents. Feeds, which is an important factor in fish farming (especially concentrates and pellets) is one of the inputs utilized by each of the fish farmers, with 54 percent being the highest percentage utilize 501-1000kg of fish feeds mostly from local source materials like groundnut cake, animal (poultry) droppings, boiled cereals/potatoes etc.

Similarly, other inputs utilized by the fishers in the area includes, fuel, ice, repair and maintenance of equipment, boat/canoes, aerators, nets, twines, floats/sinks/hooks and other accessories, but their quantity/cost are negligible and considered as sunk cost.

Structure of cost and Returns in Artisanal Fish Farming (*Lates*)

Table 4 shows the structure of costs and returns analysis in artisanal fish farming in Kede-Tifin district of Mokwa LGA.

Cost/Revenue items (₦)	Aerator units (n=96)	Non-aerator units (n=102)	Entire study area (n=198)
Variable costs:			
Fuel	99,067.11(23.71)		48,023.54(16.13)
Labour	74.375.19(17.80)	57,066.09(30.48)	65,458.38(21.97)
Ice	16,004.42(3.83)	412.31(0.22)	7,927.12 (2.68)
Feed	20,601.18(8.34)	14,327.92(7.74)	17,369.50(5,83)
Repairs/Maintenance	34,847.64(4.93)	18,202.28(9.84)	26,272.76(8.82)
Miscellaneous expenses	20,981.11 (5.02)	12,811.01(6.92)	16,772.27(5.63)
Variable costs/fish farmer:	265,876.65(63.63)	102,819.60(55.56)	181,877.56(61.06)
Fixed cost:			
Aerator/pump	59,119.38(14.15)		28,663.94(9.62)
Boat	39,511.57(9.46)	36,742.34(1985)	38.085.00(12.79)
Nets	25,557.01(6.12)	18,734.39(10.12)	22,042.33(7.40)
Twines	7,798.51(1.87)	7,642.05(4.13)	7,717.91(2.69)
Floats/sinks/hooks	9.345.83(2.24)	7,188.78(3.89)	8,234.62(2.76)
Accessories	10.548.63(2.25)	11,932.14(6.45)	11,261.34(3.78)
Fixed costs/fish farmer	151,880.92(36.37)	82,239.70(44.44)	116,005.14(38.94)
Total costs/fish farmer (N)	417,757.57(100)	185,059.30(100)	297,882.70(100)
Gross Revenue/Fish farmer	558,250.31	269,071.45	409,560.32
Less variable costs/fish farmer, TVC	265,876.65	102,819.60	181,877.56
Gross Margin (GM)	292,373.66	166,251.85	227,682.76
Less fixed Costs TFC/Fish Farm	151,880.92	82,239.70	116,005.14
Net margin/fish farmer/Year	140,492.74	84,012.15	111,677.62
Efficiency and Profitability Ratios:			
Total costs/kg	272.59	160.689	214.07
Net Margin/kg	91.67	72.95	80.26
Net Margin-to-cost ratio	34	45	37
Return on sales (%)	25	31	27

Sources: Computed from field survey data, 2010

Figures in parenthesis are percentages of total production cost/Revenues in each segment, and the entire study area.

Average annual fixed costs (FC) per fish farmer using aerator was ₦151,880.92, ₦82,239.70 for non-aerator fish farmers, while it was N116,005.14 per fish farmer in the entire area of study (Table 4). The differences in costs may be attributable to the organizational differences in production activities by the operators in different segments of artisanal fish farming. The annual operation cost per fish farming unit was ₦265.876.65 for the aerator units, ₦102,819.60 for the non-aerator units and ₦181,877.56 in the entire area.

The Net Margin per *lates* fish farmer in the sample area is Gross returns less total cost of production (TC). Net Margin per fish farmer per year in the study area was ₦140,492.74 among

aerator and pump units, ₦84,012.15 for the non-aerator and pump operators, and ₦111,677.62 in the entire study area (Table 4). The result showed that small-scale fish farming is profitable, though operators in the aerator/pump segment seem to be more lucrative.

Net Margin was 67 percent higher among the aerator and pump units than the non-aerator/pump unit. Net Margin/kg was ₦91.67/kg and ₦72.9/kg respectively for the operators in the aerator/pump and non-aerator/pump segments of the artisanal fish farming sub-sector, with an average value of ₦80.26/kg for the entire area of study. The high variable cost of production are implicated for the rather low Net Margin. The results are significantly different from those reported by Njintonjou (1998) among artisanal fishers in Limbre region of Cameroun. The return on sales, which indicates the magnitude of operating margin the fishers have on their fish sales was also calculated. It ranged from 25 percent to 31 percent, with a mean value of 27 percent for the entire area studied. The results showed very low operating margin in artisanal fish farming in Kede-Tifin district of Mokwa LGA., a condition that can be attributed to very high cost of production. The result imply that net margin was only 27 percent of gross revenue on the average. Thus, while the average net margin in the aerator/pump segment was better, the non-aerator/pump units were more profitable because they had a higher return on investment capital (45>34%) as well as higher operating margin (31>25%) than their aerator/pump counterparts.

Determinants of Output of Cultured fish (*Lates*)

The result of the regression analysis in tables 5 shows the determinants of output of fish reared in the study area. The logarithmic function was adjudged the lead equation with an adjusted R^2 value of 0.80, and 8 explanatory variables significantly affecting fish harvest (output) in consonance with a *priori* expectations. Household size had a positive influence on fish output. This implies that the larger the size of the family of the fisher, the higher the volume of fish output from aquaculture farming. This influence of household size on lates fish output may be due to the labour contribution of household members in fish farming operations as well as in processing, distribution, marketing and fish retailing. This may explain the highly significant effect of household size on fish harvest/output. Like household size, fish farming experience also exerted a positive and statistically significant effect on fish output. The more experience a fish farmer has, the higher the capability in fish farming in the face of competition and dwindling fish stocks.

The effect of labour input is also positive and statistically significant, indicating that it's another critical input in artisanal fish production. Like other farming systems, small-scale fish farming is very labour intensive and every activity in the business; from pond construction, mending of gears and crubles, harvesting, grading, processing, to marketing of fish requires an adequate amount of human-effort. Therefore, as the supply of labour increases, other things being equal, fish production/output from aquaculture will increase. Thus given existing fish stock, the input of labour in artisanal fish farming will have to be raised if fish output must be increased to meet the widening local demand.

The effect of non-fish farming income in the study area was negative and significant, indicating that as the proportion of income from other economic activities/agribusiness outside fish farming grows, fish farming level in the area will fall. In areas where there are more profitable income earning activities like trading and salary incomes, increased non-fish farming is a disincentive to fish farming; thus direct participation in fish farming will fall. The social and economic conditions in many fishing communities have improved with the implementation evasion of programmes to provide alternative source of livelihood and reduce poverty by the state and government of Niger State. Such a strategy of rural poverty alleviation and youth empowerment scheme may have stimulated alternative income generating activities in fishing communities, to the extent that the propensity to go into fish farming venture has reduced.

Adequate investment and re-investment in fish farming through injection of more capital is required to sustain output level in artisanal fish farming. This explains why desperation of capital input exerted positive and statistically significant impact on fish output in this study, and in the study area. The estimated regression results for the aerator and non- aerator segment are also shown in table 5. They are similar, as the same set of six (6) explanatory variables (except household size for non- aerator units, and feed, repairs and maintenance for aerator units) in both segments. While household size

did not exact a significant influence on fish output in the aerator segment of the small-scale fisheries, its effect among the non- aerator unit was very strong and statistically significant. A large family size constitute a pool of labour supply from which the fish farmer can draw as the need arises, especially during the schools vocation when most family members are at home.

Table 5: Regression results of determinants of output in Artisanal Fish Farming in Kede-Tifin District, Mokwa LGA, Niger State, Nigeria.

Variables	Segments		
	Aerator/pump (Linear function)	Non-aerator/pump (Linear function)	Entire study area (Logarithmic function
Educational level	65.75	78.31	0.05
	(1.45)	(1.65)	(0.84)
Household size	5.53	52.62	0.20
	(0.38)	(3.08)**	(2.31)*
Fish farming experience	156.90	75.39	0.34
	(6.55)**	(2.48)**	(4.01)**
Depreciation of capital inputs	0.009	0.003	0.27
	(0.65)	(1.64)	(2.48)**
Labour input	236.98	271.58	0.82
	(4.91)**	(5.03)**	(6.75)**
Cost of fuel/lubricants	-0.001	-0.001	-0.01
	(-1.14)	(-.79)	(-1.47)
Non-fish farming income	-0.007	-0.006	-0-10
	(-1.04)**	(-2.81)**	(-2.90)**
Cost of feed, repairs/maintenance of fishing gears	0.005	-0.001	0.001
	(1.98)*	(-0.79)	(-1.47)
Gender of respondents	328.96	385.51	0.45
	(3.46)**	(2.99)**	(4.51)**
Number of ponds	272.88	383.73	0.35
Ponds size	(2.63)**	(2.87)**	(3.24)**
	-	-	0.33
			(3.76)**
R2 =	0.87	0.83	0.80
F – value	62.92	50.07	71.13
n =	96	102	198

Figure in parenthesis are t-statistics

- **Significant at P<0.01
- * significant at P<0.05
- Source: Computed from field survey data, 2010.

Output elasticities of Lates Fish Farming

The results of the elasticity of output (*lates* fish) in the study area, with respect to specialized explanatory variables is presented in table 6. The elasticity estimates give an indication of how much fish harvest varied as a result of variation in a specified independent variable, while holding all others constant. The elasticity estimates are quite high, particularly the

variable that had statistically influence on small-scale fish production.

Table 6: Elasticity of fish output (*Lates*) with respect to specified explanatory variable: K -Tifin district, Mokwa LGA, Niger State, Nigeria.

Independent Variable	Aerator/pump Unit	Non-aerator/pump unit	Entire study area
Educational level	0.09	0.12	0.05
Household size	0.03	0.34^{5}	0.2^{5}
Farming experience	0.66	0.35^{5}	0.34^{5}
Depreciation of capital inputs	0.08^{5}	0.26	0.27^{5}
Labour input	0.69^{5}	0.81^{5}	0.82^{5}
Cost of fuel and lubricants	0.04	-0.04	-0.01
Non-fish farming income			
Cost of feed, repairs/ maintenance of fishing gears.	0.17^{5}	-0.16^{5}	-0.10^{5}
Gender respondents	0.17^{5}	0.02	0.08
Number of ponds	0.12^{5}	0.14^{5}	0.45^{5}
Pond size	0.08^{5}	0.39^{5}	0.35^{5}

5=variable that exerted significant influence on fish harvested.

Source: Computer from field survey data, 2010.

Labour was the dominant factor with an elasticity estimate of 0.82; followed by gender, 0.45; number of ponds, 0.35; fishing experience, 0.34; pond size, 033 and depreciation of capital inputs, 0.27 results showed that increased labour input will contribute significantly to the total fish output from fish farming enterprises in the study area than all other explanatory variable.

Pond size and fish farming experience also contribute significantly to fish production as indicated by the positive response of fish harvested to these variables. A 10 percent increase in the number of experienced fishers engaged in fish farming has the propensity to raise output by 3.4percent. But a commensurate increase in the number of aerator users/pump users will boost fish output from the enterprise by 3.3percent. Thus, a combination of experienced fish farmers using aerator/pump machines is a strategy that can be used to boost production levels (output) in artisanal fish farming in Kede-Tifin district of Mokwa LGA of Niger State, Nigeria.

Table 7: Constraint to Artisanal Fish farming (*Lates*)

Constraints	Frequency	Percentage	Ranking
Inadequately capital	37	18.69	1st
Insufficient supply of fingerlings	27	13.64	3rd
High cost of feeds	22	11.11	4th
Problem of flooding	18	9.09	5th
Pests and disease infestation	10	5.05	9th
High cost of transportation	28	14.14	2nd
Lack of access roads	15	7.57	7th
Conflicts among water users	14	7.07	8th
Lack of preservation and storage facilities.	18	9.09	5th
Poor marketing incentives	9	4.55	10th

Source: Field survey data, 2010

Constraints associated with *Lates* fish farming

Fish farming in general and *Lates* farming in particular is faced with a number of problems, ranging from socio-economic, pedological, pathological and physicochemical factors. In the study area, these factors (as shown in table 7), have been responsible for the government's inability to realize the full potentials of aquatic resources in the study area.

Table 7 shows that the most important of the constraints affecting fish farming by artisanal fishermen in the study area was that of inadequate capital to inject into the business, as revealed by 18.69 percent of the respondents. The fish farmers had to depend on their savings from previous incomes or incomes from other non-fish farming enterprise(s), or from informal lenders in the villages. Formal financial institutional like the banks are lacking in the area. This problem therefore ranked first among the myriads of problems. Other constraints include, insufficient supply of fingerlings for stocking (13.64%) (ranked 3rd), high cost of feeds (11.11%) (ranked 4th), high cost of transportation (14.14%) (ranked 2nd) etc.

CONCLUSION AND RECOMMENDATIONS

The capacity of artisanal fisheries to play the triple role of self-sufficiency, self-reliant and poverty alleviation strategy depends on the profitability of fish farming operations, sustenance and efficient management of fishery resources in the area. Although small-scale fish farming was found to be profitable, the low operating margin, particularly amongst fish farmers using aerator/pumps is a cause for concern. However, owing to the contribution of artisanal fisheries sub-sector in food security, poverty alleviation, self sufficiency and self reliance at both household and national level, there is the need for both government, non-governmental and private sector to review the policy of input subsidization and production credit to small-scale fishers, especially those in fish farming segments. Finally, access roads, provision of breeding stocks of fingerlings, provision of processing and preservation facilities to the fishers will go a long way in increasing the productivity and well-being of the fishers in the area.

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