ISSN: 2583-2832, Vol. 04, No. (2) 2022, Pg. 202-213

Journal of Business Strategy Finance and Management

Journal Website: jbsfm.org

Economics of Artisanal Fish Production in Gokana Local Government Area of Rivers State, Nigeria

FRANCIS EELE BORO[1] and IKECHI KELECHI AGBUGBA[1,2,3]*

[1]Department of Agricultural and Applied Economics, Faculty of Agriculture, Rivers State University, Port Harcourt, Nigeria.
[2]College of Agricultural Sciences, Cavalla International University, Hamline Ave N, Roseville, USA.
[3]Faculty of Agribusiness Management, Rome Business School (Nigerian Campus), Ikeja, Lagos State.

Abstract

The study economically analyzed artisanal fish production in Gokana Local Government Area (LGA) of Rivers State, Nigeria. Specifically, the study described the socio-economic characteristics of the artisanal fishers, determined the profitability of artisanal fishing, examined the technical, allocative and economic efficiency of artisanal fishers, and identified the constraints militating against artisanal fish production. Multistage sampling technique was employed in selecting cross-sectional data from a total of 140 fishers in the area. Descriptive and inferential statistics were employed in analysing the data for the study. Gross margin analysis indicated that the fishers earned N2, 060,277.50 (5,679.84 USD), per year and net returns of N1,891, 110.83 (5,213.47 USD) per annum with an average of N157, 592.65 (434.46 USD), per month. The benefit-costratio was 2.71 with rate of returns as 71%. The maximum likelihood estimated for the technical efficiency of the fishers indicates that gears, kerosene, bait, outboard engine were significant in the fish catch function ($P<0.01$). Age, gender, household size and mode of operations were significant factors defining the level of efficiency as revealed by the inefficiency functions of the fishers. The mean technical efficiency, average allocative efficiency and average economic efficiency recorded 0.77, 0.91 and 0.82, respectively. The study concludes that artisanal fish production is profitable and lucrative. The study recommends that in order to raise the level of efficiency amongst fishers, government and financial institutions should grant more credit facility to practicing fishers as lack of funds and inadequate capital are constraining factors facing the fishers.

Article History

Received: 27 June 2022

Accepted: 05 August 2022

Keywords

Artisanal;
Economics,
Efficiency;
Fish;
Fishers;
Nigeria;
Production.

CONTACT Ikechi Kelechi Agbugba ikechi.agbugba@ust.edu.ng Department of Agricultural and Applied Economics, Faculty of Agriculture, Rivers State University, Port Harcourt, Nigeria.

Doi: http://dx.doi.org/10.12944/JBSFM.04.02.03

Introduction

Fish production in Nigeria is obtained from two main subsectors, capture fishery and aquaculture.[1] Capture fishery which involves harvesting of naturally occurring fish resources in both marine and freshwater environments may be further divided into artisanal and industrial fish production.[2] Artisanal fish production is characterized by little scale fishers that operate in the marine, shore, creeks and remote water bodies using dug-out or improved canoes usually 2 to 5 persons onboard according to the type of fishing engage in.[3] Industrial fishing activities in Nigeria compresses trawling for finfish, demersal and other fishes while aquaculture compress fish production in a controlled system.[4]

Nigeria is favoured with abundant of less salt content and brackish marine water bodies that are possessed by various types and species of fishes that supports artisanal fisheries.[5] As asserted by,[6] artisanal fish activities contribute for over 80% of the aggregate fish creation in Nigeria. The Atlantic Ocean and creeks are the major sources of artisanal fish production in Rivers State.[7]

According to[8] it is common to find females participating actively in creak fishing using local dugout small-sized canoes, usually propelled by paddle, while their male counter parts exploit the ocean using improved canoes. Such canoes are further developed with outboard engines of different horse-powers ranging from 15 to 45 mostly operating within 5 nautical miles (non-trawling zone). Gears such as cast nets, traps, drag nets, drift nets, line hooks, baskets and monofilament gill net for catching various species and sizes of fish are used by the fishers.[4]

Artisanal fishing remains essential sources of nourishment, income and employments for many individuals in Nigeria. Increase inthe fish production both for quantity and quality is required to meet up the dietary needs of the populace and in turn necessary to building a healthy nation.[9] Proteins obtained from the consumption of fish is embedded with the basic essential amino acids including lysine, methionine and fats not saturated which usually are low in cholesterol, in this way, persistent fish consumption does not pose any threat of heart attack compare to other sources of animal proteins.[10]

Economically, artisanal fisheries offer both direct and indirect employment opportunities to millions of Nigerians especially the coastal dwellers. Direct employment from artisanal fisheries compresses those who are engaged in capture fishery production, processing and marketing activities. The production of fishing inputs and suppliers such as dugout canoes, gears, sinkers, fish feedmill, fishing vessels, floats, nets and owners of restaurants are indirectly employed in the artisanal fishery subsector (Food and Agriculture Organizations.[11] An estimated 25 million fishers are employed in artisanal fisheries in Nigeria but how efficient they are in the utilization of resources in the production process still remained a critical matter of empirical determination throughout the country because majority of the fishers are resource-poor.[12]

Economically, efficiency occurs when the cost of producing a given output is as low as possible and it is made of technical and allocative efficiency. Technical efficiency may be described as the most extreme achievable level of yield for a given level of creation input, with the best technology available to the farmers. Then again, allocative efficiency may be achieved if a farm is able to make its marginal value product to be equal its marginal cost. Efficiency is very much required to achieve the desired growth and demand in artisanal fish production in Nigeria.[13]

The demand for fish in Nigeria keeps rising rapidly because of persistence rise in population and high price of alternative sources of animal protein. According to,[14] the domestic supply of fish in the last decades has not satisfied the demand, hence creating demand-supply deficient. The projected demand for fish in Nigeria based on 180 million population estimates is 3.32 million metric tonnes per annum while the local fish creation from artisanal, controlled sources and industries fishing activities is about 1.123 million MT yearly, creating a gap of about 2.197 million metric tonnes. This situation has left the country with the option of massive importation of fish, spending more than N145 billion annually.[15]

The fundamental problem of artisanal fish production in Nigeria can be grouped into three broad categories. Firstly, the challenge to enhance fish generation performance and in the mean time keeps up a maintainable level of fish population. Secondly, poor execution of regulations against excess exploitation of fish even in the face of poverty poses a challenge. Thirdly, environmental problems such as water pollution as a result of oil spills, gas flaring, industrial wastes and destruction of fish breeding grounds through use of dangerous chemicals to kill fish.[16]

Over the years, the operational mode of artisanal fisheries has experienced little or no change with the fisher folks still employing rudimentary techniques and gears for several decades.[17] Most worrisome to these challenges, according to,[18] are that neither the fishers nor the fishing communities have the capacity to improve their mode of operation because of inadequate catch, abysmal income, surprising expense of fishing gears, lack of credit, lack of storage facilities, marketing issues and environmental degradation. Regrettably, government at all levels, non-governmental and international organization have not given adequate attention to solving the challenges faced in this economically and food provisional subsector. In addition to the above challenges is the critical issue of efficiency in artisanal fish production in Nigeria where assets are pitiful meager and open doors for creating as well as receiving better advancements are waning.

Regardless of the critical commitment of artisanal fishers to fish generation in Nigeria, little research works have economically analyze artisanal fish production in various parts of the country.

Purpose of the Study

The broad objective of the study was to analyse the economics of artisanal fish production in Gokana Local Government Area (LGA)of Rivers State. The specific objectives were to.

- describe the socio-economic characteristics of artisanal fisher folks;
- determine the profitability of artisanal fishing;
- examine the technical, allocative and economic efficiency of artisanal fishers;
- identify the constraints militating against artisanal fish production.

Materials and Methods

The study was carried out in Gokana LGA of Rivers State, Nigeria. The area is one of the 23 LGAs of Rivers State with headquarters at Kpor. The area, which is situated in the South-South geopolitical zone of Nigeria within the South-East Senatorial District of Rivers State, which has both riverine and upland communities. It is bounded in the North by Khana, South by Andoni and Bonny, East by Okrika and West by Tai LGAs.

According to,[19] the area has a total population of 288,828 persons comprising 170,606 males and 118,222 females residing in the area (126 km^2). The indigenes of the area communicate in "Gokana," which is their common dialect and "English" as second language. The artisanal fishing industry is an important sector in the area and the fisheries resources constitute both the traditional and primary source of livelihood of most communities. The area has many rivers, creeks and estuaries flowing into the Gulf of Guinea and Atlantic Ocean with various species of fish including sharks, croakers, bonga, sardines, catfish, crabs, periwinkles and shrimps.

The research design for the study is survey method, which involved using a representative sample of the population for the study. This method involving a collection of information from a sample of respondents using tools such as structured questionnaire, personal interviews and observation to avoid biased opinions that could influence the outcome of the study.

The population of the study included all artisanal fishers comprises male and female in Gokana LGA. According to.[20] there are no available register for artisanal fishers in the study area. However, based on the consultation from the Department of Agricultural Extension in the Council, data on fishery issues are usually extracted from riverine communities.

Gokana LGA is divided into sixteen (16) communities: Kpor, Bodo City, Biara, Deeyor, B-Dere, K-Dere, Bera, Nwe-ol, Mogho, Bomuu, Yeghe, Deken, Lewe, Gbe, Barako and Nwebiara.

Multistage sampling technique was used for the study. The first stage involved purposive selection of 7 out of the 16 communities, based on the consultation from the department of agricultural extension in the LGA. The communities are: Bodo City, K-Dere, B-Dere, Bomu, Gbe, Mogho and Kpor because they are riverine and actively involved in artisanal fish production. The second stage was random sample selection of 20 artisanal fishers from each of the 7 communities previously selected, giving a total of 140 respondents for the study.

Gross Margin

The formula for the gross margin was defined as follows.

$$GM_i = TR_i - TVC_i = \sum P_i Q_i - \sum C_{ij} X_{ij} \qquad ...(1)$$

Where

Gm = gross margin

TR = Total value of different species of fish caught (in Nigerian naira, NGN) for range i-th fishers

TVC = Total variable costs for fishes caught (in NGN) for range i-th fishers.

Pi = price of fishes (NGN per kg)

Qi = Quantity of fishes caught for i-th fisher

Cij = Cost per unit of j-th input utilized for range i-th fisher

Xij = Amount of j-th changeable input utilize for range i-th fisher

The study adopted the Stochastic Production Frontier Model (the Cobb-Douglas functional form) using frontier 4.1 software, because it is easier to compute and interprets used by[21,18] to examined the technical, allocative and economic efficiency of the fishers. Hence, the stochastic frontier function equation for little scale fishers is specified as follows.

a) $Q=f\{XLNX_i\} \exp \{v_i-u_i\}$ ...(2)

Q = Dependent variable

X, L, N and X = Independent variables

vi – ui = coefficient

To put the variables on the same scale, equation 2 is linearized as follows.

$\ln Q=\ln\alpha_0+\ln\alpha_1 \text{ SGR}+\ln\alpha_2 \text{ VESE1}+\ln\alpha_3 \text{ GRHP}+\ln\alpha_4 \text{ CREW}+\ln\alpha_5\text{PTRO}+\ln\alpha_6 \text{ KRO}+\ln\alpha_7 \text{ Oil}+\ln\alpha_8 \text{ BIAT}+\ln\alpha_9 \text{ FUD}+\ln\alpha_{10} \text{ BATRY}+\ln\alpha_{11} \text{ MIS}+v_i-u_i$ ...(3)

Where

Q = Level of fish catch in kg

SGR = Fishing gear length in meter

VESEL = Canoe size (length) in meters

GRHP = Outboard engine capacity in Horse power

CREW = Crew number unit vessel for fishing trip

KRO = Utilized kerosene (litres)

OIL = for fishing trip

BIAT = Utilized baits for fishing trip

FUD = Utilized food for fish trip (kg)

BTRY = for fishing trip

MIS = Miscellaneous variables including boxes, plastic containers

α_0 = Constant term

α_1-α_{11} = Coefficients

Ln = Natural logarithm

Vi-Ui = Error terms

On the A priori, the study expects

α_1, α_2, α_3, α_4. α_5, α_6, α_7, α_8, α_9, α_{10} and $\alpha_{11}>0$

Allocative Efficiency

Allocative efficiency is the ability of a farm to equate Marginal Value Product and Marginal Cost.

Cobb-Douglas allocative function equation for this research utilized in[21] is explicitly

linearized as follows

$\ln TV = \beta_o + \beta_1 \ln DFG + \beta_3 \ln DOE + \beta_4 \ln EXC + \beta_5 \ln EXP + \beta_6 \ln EXB + \beta_7 \ln EXF + \beta_8 \ln MIS + Vi\text{-}Ui.$

Where

TV = Total amount of fishes' receipts sold, and value consumed (NGN)

DFG = Depreciative amount of fishing gears (NGN)

DFV = Depreciative amount of fishing vessel values (NGN)

DOE = Depreciative amount of engine (NGN per horse power)

EXC = Expenditure for Crews (NGNper trip)

EXP = Expenditure on fuel (litres)

EXB = Paddle (NGN)

EXF = Expenses on Food (NGN)

MSC = Amount spent on miscellaneous item, including paddle, oil, battery, plastic box.

In = Natural logarithm

βo = constant term

A priori 2: β_1, β_2, β_3, β_4,β_5,β_6,β_7,β_8,β_9,β_{10} and $\beta_{11}>0$

Vi-Ui = as defined earlier

Economic Efficiency

Economic efficiency is a product of technical and allocative efficiency which was obtained as.

$EE=TE \times AE$ ...(4)

Where
EE = Economic Efficiency
TE = Technical Efficiency
AE = Allocative Efficiency

Inefficiency Functions

The inefficiency function model is expressed as

$$U_i=\alpha_0+\sum\alpha_{ni} Z_{ni}+\alpha D_{ni} \ n=1$$

Where
Zni = Fishers' specific variables such education, age, gender, years of fishing, fishing trip, family size and duration of fishing per day.

Results and Discussion

Socio-Economic Characteristics of the Respondents

Results from the socio-economic characteristics of the respondents are presented in Table 1. These included gender, age, level of education, family size, fishing experience, use of credit, mode of operation and duration of fishing trip per day.

Table 1: Socio-Economic Characteristics of the Fishers

Variables	Frequency	Percentage	Mean
Gender			
Male	114	81.43	
Female	26	18.57	
Total	140	100.00	
Age (years)			
< 26	12	8.57	
26-45	79	56.43	
46-65	42	30.00	42 years
>65	7	5.00	
Total	**140**	**100.00**	
Level of education			
No formal education	22	15.71	
Primary education	67	47.86	
Secondary education	46	32.86	
Tertiary education	5	3.57	
Total	**140**	**100.00**	
Family size			
1-5	28	20.00	
6-10	45	32.14	
11-15	32	22.86	
10 persons			
>15	35	25.00	
Total	**140**	**100.000**	
Fishing experience (years)			
1-5	10	7.14	
6-10	21	15.00	
11-15	37	26.43	13 years
>15	72	51.43	
Total	**140**	**100.00**	
Use of credit			
Yes	49	35.00	
No	91	65.00	

Total	**140**	**100.00**	
Number of trips			
Once a day	92	65.71	
Twice a day	13	9.29	
Once every other day	35	25.00	
Total	**140**	**100.00**	
Mode of operation			
Use of outboard engine	36	25.71	
No use of outboard engine	104	74.29	
Total	**140**	**100.00**	
Duration of fishing trip/day			
4-5hours	4	2.86	
6-7 hours	16	11.43	
8-9 hours	48	34.29	9 hours
>9 hours	72	51.43	
Total	**140**	**100.00**	

Source: Field Survey, 2018

Gender

As indicated in Table 1, majorities of the respondents were male (81.43%) and female (18.57%). This result implies that both male and female were involved in artisanal fishing production but dominated by male in the area.

Age

The age distribution of respondents presented in Table 1 revealed that most of the fishers were between 26-45 years which represented 56.43%. This was followed by the age bracket between 46-65 years (30%). Other age group were less than 26 years (8.57%) and above 65 years (5.00%). The mean age of the respondents was 42. The result indicates that artisanal fishing activities in the area were dominated by people in their economically and more active age bracket. This is consistent with artisanal fishery study by,[21] who opined that artisanal fishery operators lately tend to be younger and nimble in seeking for larger level of effectiveness.

Level of Education

As indicated in Table 1, 15.71% of respondents have no formal education, 47.86% had primary education, 32.86% had secondary education and only 3.57% had tertiary education. This result revealed that generally, the respondents were educated.

Family Size

In Table 1, the family size of the respondents was categorized into four groups as follows 1-5 members (20.00%), 6-10 members (32.14%), 11-15 members (22.00%) and above members (25.00%). With the mean of 10 members' household size, it implies that the artisanal fishers have large families which are often associated with availability of timely labour as confirmed with similar research by.[22]

Fishing Experience

Data in Table 1 indicate that majority of the respondents (51.43%) had fishing experience for above 15 years followed by 11-15 years (26.43%), 6-10 year (15.00%) and 1-5 years (7.14%). The mean fishing experience was 13 years. This implies that most of these respondents had been in fishing profession for at least 13 years. Many years of fishing experience could be an indication of the practical knowledge for the fisher folks to know where fish go and span, current and tides pattern and the ability to maneuver gears effectively.

Use of Credit

Table 1 indicated that 35.00% use credit and 65.00% did not used credit in fishing expeditions. Fishers often borrow to satisfy their socio-economic challenges in time of lack. This result equally implies that majority of respondents did not use credit which probably was due to the non-availability of credit lending institutions in the study area. This finding aligns with that of[23] on feed input and cost analysis of catfish and tilapia production in Ogba/Egbema/Ndoni Local Government Area of Rivers State, Nigeria.

Number of trips

as shown in Table 1, 65.71% of the respondents reported going fishing once a day, 9.29% twice a day, 25.00% once every other day. The implication of this result is that majority of the fishers were serious about artisanal fishing expedition every day.

Mode of Operation

Table 1 shows that 25.71% used outboard engine while majority (74.29) of respondents do not used outboard engine in fishing expedition. The implication of the result is that some fishers in the study area were using outboard engine for fishing which likely improved their catch level.

Duration of Fisher Trip Per Day

As reported in Table 1 most of the fishermen spent above 9 hours per day on fishing expedition which represented 51.43%. Others are between 8-9 hours (34.29%), 6-7 hours (11.43%) and 4-5 hours (2.86%). The mean duration of fishing trip per day was 9 hours. This result is supported by Kingdom (2009) who reported that an average artisanal fisher in the Niger Delta normally spend at least 9 hours in fishing trip per day.

Gross Margin Analysis of an Average Fisher in the Study Area

Table 2 presented the results of gross margin analysis of a little scale fishers in the place of the research. The result indicated that revenue accruable after the various fishes were sold at the unit price of N450.00 per kilogram totaling N2, 994,151.50, per annum. This finding is shared by,[18] who reported an annual revenue of N3,959,000 for artisanal fish production in Akwa Ibom State, Nigeria.

Table 2: Gross Margin Estimation of a Fisher averagely

Variables	Output (kg)	Price (N/kg)	Total (N)
A. Revenue			
Sales of fishes	6,305.67	450	2,837,557.50
Quality consumed	348.00	450	156,600.00
Total			2,994,151.50
Variable Cost			
Fuel			142,486.00
Oil	24,536.00		
Kerosene			18,980.00
Bait			12,130.00
Food			110,000.00
Battery			8,000.00
Wages on crews			6,12,942.00
Maintenance			4,800.00
B. Total variable cost			**933,874.00**
C. Gross margin (A-B)			**2,060,277.50**
Fixed costs (depreciated value)			
Canoe /vessel			41,666.67
Gear			15,000.00
Paddle			4,000.00
Outboard engine			100.000.00
Miscellaneous			8,500.000
D. Total fixed cost			**169,166.67**
Total cost (B+D)			1,103,040.67
E. **Net returns (C-D)**			**1,891,110.83**
Net return per month			**157,592.57**
Probability Index			
Benefit-cost ratio (A/E)			**2.71**
Rate of returns (F/E)			**171%**

Source: Field Survey, 2018

As indicated in Table 2, the gross margin was N2, 060,277.50. The total variable costs were N933, 874.00 and total fixed cost was N169, 166.67. The result further shows a net return per month of N157, 592.57. The benefit-cost ratio which indicates the profitability was at 2.71, implying that for every one naira invested in artisanal fish production two-naira, seventy-one kobo would be gained.

In addition, the return to capital (rate of returns) was 171% indicating that for every one naira invested about N171 was benefited. This result suggests that artisanal fish production in the study area was profitable. This is in agreement with,[24] who asserted that artisanal fish production is a profitable enterprise.

Technical Efficiency and Inefficiency Model of the Fishers

The maximum likelihood estimates of Cobb Douglas catch function, with corresponding standard errors for technical efficiency and inefficiency function are presented in Table 3. From the result of the technical efficiency model, fishing gears, canoe/vessel, engine, crew, oil, food and battery were positively related with output. The pointer here is that a unit percentage increment in these variables caused an increment in the quantity of fishes captured. However, battery, engine and fishing gear were significant at 5% level. Implying that if larger of these creation inputs are utilized, the more catch level, all things being equal.

Moreover, Table 3 also presented inefficiency model. It is important to note that coefficient signs associated with the inefficiency function are elucidated in a reversed way. Thus, a positive sign implies that the particular variable decrease efficiency while a negative coefficient indicated increase in efficiency level.[21] Meanwhile, the results revealed that age, trips, education, mode of operation and gender were positive while duration of trip, household size and years of experience were negative. The implication of these result for example the negative sign of years of experience indicates that as fishing years' increase the fishers appeared to be efficient more in fish production by 4.2%

Furthermore, sigma Square (σ^2) value was 0.067, revealing the level of variation of technical efficiency

Table 3: Maximum Likelihood Estimate of Technical Efficiency and Inefficiency Model of Sampled Fishers

Variable	Maximum Likelihood Estimate
Catch function	
Intercept	7.014(7.242)*
Ln Gear	0.108(3.08)*
Ln Vessel	0.068(0.664)
ln Engine	0.187 (3.74)*
Ln Crew	0.083(0.980)
Ln Fuel	-0.002(-0.146)
Ln Kero	-0.039(-1.2)
Ln Oil	0.005(0.656)
Ln Biats	-0.064(-1.234)
Ln Fud	0.062 (0.662)
Ln Btry	1.053 (3.706)*
Ln Mis	-0.045(-0.486)
Inefficiency model	
Intercept	1.211(-1.783)*
Ln Ed	0.016(0.203)
Ln Ag	0.567(3.206)*
Ln Ex	-0.042(-0.512)
Ln Ntrip	0.028 (0.256)
Ln Hosiz	-0.413(-4.203)*
Ln Dura trips	-0.161(-1.387)**
Ln Gder	0.046(0.145)
Ln Cdit	0.528(3.457)*
Ln Mp	0.052(-1.123)
Diagnosis Test	
Sigma square ($\sigma 2s = \sigma 2u + \sigma 2v$)	0.067 (11.103)
Gamma $\gamma = \sigma 2u/\sigma 2s$	0.012(0.237)
Log Likelihood Function	-54.732
LR Test	79.626
Mean TE	0.77

Source: Author's Computation using frontier 4.1 software; t-statistics (parentheses)
Probability values: *5% significant;
**10% significant
P <0.01=2.58; P <0.05=1.64 and P <0.10= 1.28
Key: Biats = baits; fud = food; Btru = Battery; Mis= miscellaneous; Ed = education; Ag = Age; Ex = Experience; Ntrip = No. of trips; Hosiz = Household size; Dura trips = duration of trip; Gder = Gender; cdit = credit & Mp = mode operation.

and the accuracy of the prescribed distribution hypothesis of the composite stochastic terms.

The gamma (γ) worth was 0.012 showing the measure of variation as a result of the technical inefficiency of the fishers. This indicated that about 1.2% of variation in catch level of fishers were as a result of technical inefficiency effect. The remaining 98.8% is due to factor beyond the control of the fisher folks. The mean technical efficiency (TE) was 0.77, implying that the output level could still be increased by about 23% if better fishing technologies are adopted.

Estimated Allocative Efficiency and Inefficiency model of the Fishers

Table 4 presented the assessment of the Cobb Douglas production frontier for the allocative efficiency for fishers. The result disclosed that gear, vessel/canoe, engine, crew, petrol, kerosene, oil and bait were positive but not allocatively significant. On the contrary, the costs of food, battery and miscellaneous were negative.

Further, the inefficiency model indicated that all the variables were negative. As noted earlier, coefficient negatively signed as appeared in inefficiency model imply that variables under consideration have the capacity to increase allocative efficiency and vice versa. Meanwhile, the negative of the level of education imply that fishers with more education years were more allocatively efficient as agreed with the study of,[25] who found out that more years of schooling help artisanal fishers to be less allocatively inefficient.

The experience coefficient in fishing years shown also negative signal indicating as years increase in artisanal fishing, fishers become allocatively efficient increasingly. This result is in conformity with,[18] who detected that experience in years in inefficiency function was negatively discovered. Similarly, the negative sign in the number of trips the fisher folk goes for fishing, the less allocatively inefficient they were. This line of explanation applies for all the negative variables as influencing factors of artisanal fishers' efficiency in the area.

Moreover, test statistics (diagnostic) revealed the sigma square as 0.82 meaning that there was a wide variation in the level of allocative efficiencies.

Table 4: Estimated Allocative Efficiency and Inefficiency Model for the Fishers

Variables	Maximum Likelihood Estimates
Allocative function	
Intercept	7.617 (7.623)*
Ln Gear	0.001 (0.00095)
Ln Vessel	0.001(0.0011)
Ln Engine	0.005(0.049)
Ln Crew	0.993 (1.2305)
Ln Fuel	0.003(0.025)
Ln Kero	0.001(0.0012)
Ln Oil	0.0043(0.10)
Ln Bait	0.002(0.0021)
Ln Food	-0.004(-0.0044)
Ln Battery	-0.861(-0.904)
Ln Miscellaneous	-0.003(-0.0029)
Inefficiency model	
Intercept	-0.038(-0.0379)
Ln Edu	-0.074(-0.7625)
Ln Age	-0.145(-0.1623)
Ln Exp	-0.115(-0.1242)
Ln Ntrip	-0.167(-0.1958)
Ln Hhsize	-0.062(-0.0630)
Ln Duration of trip	-0.051(-0.0515)
Ln Gender	-0.026(-0.0260)
Ln Credit	-0.008(-0.0082)
Ln Mo	-0.015(-0.01523)
Diagnosis test	
Sigma square ($\sigma 2s = \sigma 2u + \sigma 2v$)	0.816(1.121)
Gamma $\gamma = \sigma 2u/\sigma 2s$	0.885(63.452)*
Log Likelihood Function	281.107
LR Test	1823.782
Mean AE	0.908

Source: Author's Computation using frontier 4.1 software t-statistics (parentheses)
Probability value: * 5% significant
(P<0.01=2.58; P<0.05=1.64; P<0.10= 1.28)

This equally implies that the fishers still have high opportunities to raise efficiency level. The gamma value (0.89) depicts the variance size connected with the allocative function which shows that 89% change in product of the fishers is caused by the alikeness in allocative efficiency. Finally, the number 0.908 was the average allocative efficiency, implied that up to 10% is lost as a result of wastefulness in how input and price mix of the artisanal fishing were manipulated.

Estimated Economic Efficiency and Inefficiency Function

The results in Table 5 unveils the economic efficiency and inefficiency model. The overall efficiency (economic efficiency) was computed through technical and allocative efficiency and then regressed against the specific variables in the model.

Table 5: Estimated Economic Efficiency and Inefficiency Model for the Fishers

Variables	Maximum Likelihood Estimate
Inefficiency model	
Intercept	-0.172(11.25)*
Ln Edu	-0.172(-0.350)
Ln Age	-0.152(1.687)*
Ln Exp	0.00716 (2.41)*
Ln Ntrip	0.037(0.813)
Ln Hhsize	-0.124(-2.03)*
Ln duration of trip	-0.0665(-1.53)**
Ln Gender	-0.0653(-0.45)
Ln Credit	-0.013(-0.625)
Ln Mo	-0.0248(-5.13)*
Diagnosis test	
Sigma square ($\sigma 2s = \sigma 2u + \sigma 2v$)	-0.317(8.46)*
Gamma $\gamma = \sigma 2u/\sigma 2s$	0.97(139.2)*
Log Likelihood Function	260.56
LR Test	120.39
Mean EE	0.82

Source: Author's Computation using frontier 4.1 software t-statistics (parentheses)
Probability values: * 5% significant, ** 10% significant
P <0.01=2.58, P <0.05=1.64 and P <0.10= 1.28

As indicated in the Table 5, almost all the variables such as education, age, household size was negatively signed meaning that such chip in positively to the elucidation of the overall efficiency of the artisanal fishers in the place of study. The coefficient of year of experience was positively signed, was contrary to expectation, however, it was significant. In his study,[22] made a similar observation that years of fishers' experience give them better understanding of fish location, trend in weather, condition of currents/tides, fish migration pattern and the better ways to harvest fish, thereby contributing to its economic efficiency.

Result further showed that the sigma square (0.317) is critical at 5% level of probability. Meanwhile, averagely, the mean economic efficiency (0.82), indicates that the artisanal fishers create nearly 82% of the output utilizing the current fishing practices and prices of inputs.

In this manner, the fishers forgo about 18% economic efficiency. Therefore, there is a potential for raising fishers' output at an average degree(18%) if better practices are adopted by the fishers.

Table 6: Major Constraints Encountered by Artisanal Fishers

Constraints	Frequency	Percentage
High cost of fishing gears	127	90.71
Oil spillage	132	94.29
Lack of credit	112	80.00
Decline in fish yield	131	93.57
Over exploitation of fish	122	87.14
Inadequate capital	109	77.86
Use of toxic chemicals to kill fish by others	95	67.86
Lack of storage facility	128	91.43
Bad weather	88	62.85
Piracy/ insecurity of water ways	134	95.71

Source: Field Survey, 2018 *Multiple response

Major Constraints encountered by Artisanal Fishers

The major constraints militating against artisanal fish production in the various fishing sites in the study area as identified are indicated in Table 6. These challenges as listed by the fishers in their multiple respondents include high cost of fishing gears (90.71%), oil spillage (94.29%), lack of credit (80.00%), decline in fish yield (93.57%), over exploitation of fish (87.14%), inadequate capital (77.865%), use of toxic chemicals by other fishers (67.43%), lack of storage facility (91.43%), bad weather (62.85%) and piracy (95.71%). The artisanal fish subsector is affected negatively by these constraints which ultimately may lead to profit and income reduction of the fisher folks. This result is in conformity with,[26] who reported similar constraints in their review of factors affecting sustainable artisanal fish production in the Niger Delta, Nigeria.

Conclusion

The study was on economics of artisanal fish production in Gokana Local Government area of Rivers State, Nigeria. The study specifically determined the socio-economic characteristics of respondents, examined the profitability of artisanal fish production, estimated the technical, allocative and economic efficiency of artisanal fish production and identified the major constraints against artisanal fish production. It is established that artisanal fish production is a profitable enterprise. However, there was an observed level of inefficiency amongst the fishers in the area but there was equally a potential of raising fish output level by 18% through the adoption of better technology as the average economic efficiency was 82%.

Recommendations

Governments at all levels should subsidize the cost of fishing gears to cushion the effect of high cost as this is one of the factors militating against effective artisanal fish production in the area in order to raise the level of efficiency amongst fishers, government and financial institutions should grant more credit facility to practicing fishers as lack of fund and inadequate capital are serious problems facing the fishers modern and efficient post-harvest storage facilities should be provided at fishing communities to encourage fishermen to store their products and avoid wastage as there is peak and slack period of catch. This will equally increase fishers' income by helping them to selling the produce at a later period of higher prices and oil exploration and other industrial activities should be carried out in a professional manner such that little or no damage should be done to the aquatic resources in the area. Where damage occurs remediation should be carried out immediately and adequate compensations paid to the fishers accordingly.

Acknowledgement

The author would like to thank the academic members of the Department of Agricultural and Applied Economics, as well as the academic resources of the Faculty of Agriculture, Rivers State University for reviewing research work.

Funding

The authors did not received any funding for the ublication

Conflict of Interest

There is no Conflict of Interest

References

1. Yakubu, S. (2022). "Study explores how Nigeria can achieve its fish production target, Institute of Aquaculture, University of Sterling, UK." Available from: https://www.stir.ac.uk/news/2022/may-2022-news/study-explores-how-nigeria-can-achieve-its-fish-production-target/
2. Namso, N.F., Gabriel, S.U. (2016). "Technical efficiency in artisanal fishing in Akwa Ibom state, Nigeria." *Food Science and Quality Management*, 22-31.
3. FAO, (2015). "Voluntary Guidelines for securing sustainable small-scale fisheries in the context of food security and poverty eradication." Rom. 18; Available from: https://www.fao.org/voluntary-guidelines-small-scale-fisheries/en/
4. Patil, H.J., Benet-Perelberg, A., Naor, A., Smirnov, M., Ofek, T., Nasser, A., Minz, D. & Cytryn, E. (2016) Evidence of Increased Antibiotic Resistance in Phylogenetically-Diverse Aeromonas Isolates from Semi-Intensive Fish Ponds Treated with Antibiotics. *Front. Microbiol.* 7, 1875. doi: 10.3389/fmicb.2016.01875
5. Akankali, J.A., Oronsaye, J.A.O. (2010). "Economic assessment of crude oil pollution impact on artisan fishery in some Local Government Area of Delta State, Nigeria." Proceedings of 20th Annual Conference of Fisheries Society of Nigeria (FISCON), Port Harcourt, 460-466. Bada, A.S. (2015). "Strategic for bridging the supply-demand gap in fish production in Nigeria." A Proceeding of the 19th Annual Conference of the Farm Management Association of Nigeria, 329-337.

6. Boro, E. F. (2018). "Economics of Artisanal Fish Production in Gokana Local Government Area of Rivers State, Nigeria," Unpublished MSc Project, *Department of Agricultural and Applied Economics, Rivers State University, Nigeria.*
7. Kingdom, T.K. (2009). "A survey of fishing gear and methods in the lower Taylor Creek Area of Bayelsa State." *World Journal Fish Marine Sciences,* 1 (4), 313-319.
8. Ayotunde, E.O., Oniah, M.O. (2012). "The socio-economic status and artisanal fishers in Cross-Rivers State, Nigeria." *World Journal of Fish and Marine Sciences,* 6(7), 672-678.
9. Agbugba, I.K. (2018). "Smallholder Fresh Fish Marketing Enterprise: A Veritable Livelihood Strategy for Economic Empowerment in sub-Saharan Africa (Keynote Paper)," AGROTECHNOLOGY: Proceedings of the International Conference on Agriculture, *Food and Aqua,* 7(2), 23.
10. FAO (2016). "Blue growth–unlooking the potential of seas and oceans." Available from: www.foo.org/zhc/detai/-event/en/c233765/.
11. Faturoti, O. (2010). "Nigeria, fisheries contribute $US 1 billion to economy." 25th Annual Conference of Fishery Society of Nigeria; Badagry, Lagos, Nigeria.
12. Anene, A., Ezeh, C.I. (2010)."Resources use and efficiency of artisanal fishing in Oguta, Imo State, Nigeria." *Journal of Development and Agricultural Economics,* 2 (3), 094-099.
13. Nwabeze, G.O., Erieze, A.P. (2013). "Artisanal fisheries and sustainable fisheries management practices in the Jebber Lake basin, Nigeria." *Journal of Agricultural Extension,* 2(3), 123-134.
14. Fishery Committee for the West Central Gulf of Guinea (2016). "Nigeria fishery statistics, A summary report." Available from: https://fcwc-fish.org/tag/nigeria-fishery-statistics-2016-summary-report.
15. Inoni, O.E., Oyaide, W.J. (2007). "Socio-economic analysis of artisanal fishing in the South Agro-Ecological Zone of Delta State, Nigeria." Agricultural Tropical ET Subtropical, 40(9), 135-149.
16. Alhaji, T.H., Jim-Saiki, L.O., Giwa, J.E., Adedeji, A.K., Obasi, E.U. (2015). "Infrastructure constraints in Artisanal Fish Production in the Coastal Area of Ondo State Nigeria." *International Journal of Research in Humanities and Social Studies,* 2 (5), 22-29.
17. Namso, N.F., Gabriel, S.U. (2016). "Technical efficiency in artisanal fishing in Akwa Ibom state, Nigeria." *Food Science and Quality Management,* 22-31.
18. NPC (2006): National Population Commission, Provisional Census Figure of Nigeria. Akankali, J.A., Nwafili, S.A. (2017). "An assessment of the socio-economic impact of crude oil pollution on aquaculture in Gokana Local Government Area of Rivers State, Nigeria." *Nigerian Journal of Fisheries and Aquaculture,* 5(1),87-94.
19. Kareem, R.O., Idowu, E.O., Ayinde, I.A., Badmus, M.A. (2012). "Economic efficiency of freshwater Artisanal Fisheries in Ijebu Waterside of Ogun State, Nigeria." Global *Journal of Science Frontier Research Agriculture and Veterinary Sciences,*12 (11), 112-119.
20. Unongo, T. (2010). "Economic analysis of artisanal fishing enterprise in Gumal Local government area of Benue State, Nigeria." Unpublished MSc. Dissertation, Department of Agricultural Economic, University of Nigeria, Nsukka, Nigeria; Available from: http://www.unn.edu.ng/publications/files/images/UNONGO%20THOMAS.pdf
21. Agbugba, I.K., Ifeanyi-Amos, E., Binaebi, E. (2019). "Feed Input and Cost Analysis of Catfish and Tilapia Production in Ogba/Egbema/Ndoni Local Government Area of Rivers State Nigeria," Delta Agriculturists, 11(1/1), 1-9.
22. Dawang, C.L., Manggoel, W., Dasbak, M.A. (2012). "Economic efficiency estimates of captured fisheries in Plateau State, Nigeria: A case study on Pandam Lake fisheries innovation techniques." *Journal of Economics and Sustainable Development*,3 (5),23-36.
23. Akanni, K.A. (2012). "Catch level and capital investment of artisanal fishermen in Lagos State,Nigeria." Turkish *Journal of Fisheries & Aquatic Science,* (8), 361-368.
24. Akankali, J.A., Jamabo, N.A. (2011). "A review of some factors militating against Sustainableartisanal fisheries development in Niger Delta, Nigeria." *Asian Journal of Agricultural Sciences,* 3(5), 369-377.