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Full Length Research Paper

Economic performance of crab fishery in Lagos lagoon, Nigeria

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The study evaluates the economic performance of small-scale crab fishery operations in terms of economic indicators and success performance during 2009 and 2010 fishing season in five lagoon systems in Lagos state. The objectives of the study were to state economic viability of the crab fishing activity and to identify factors influencing the cost structure. Initial analysis reveals that a large variation in cost structure exists in the crab fishing in Lagos lagoon. Economic results of the study showed that small-scale crab fishing have a positive net profit and fully recover their costs, with no losses. The net cash flow, economic and financial performance of the crab fishers was very satisfactory. The result shows that increasing catch decreases costs implying that scale and improving efficiency is key to reducing cost.

Key words: Crab fishery, economic viability, economic performance, returns on capital, Lagos lagoon.

INTRODUCTION

The mud crab (*Callinectes amnicola*) is widely distributed throughout the Lagos lagoon and forms the basis of valuable fisheries in the lagoon system. Wherever the species occurs, it is exploited by both commercial and subsistence fishermen and is in high demand because of its good flavour. The crab fishery in Lagos lagoon systems is not a competitive fishery and entry is relatively inexpensive with a potentially high return. Due to paucity of data and methodological inconsistencies, there does not seem to be a proper assessment of crab fishing capacity (Adeogun et al., 2009). As in the case of capacity, knowledge of the status of fishery resources is also insufficient, despite the rapid and continued development of fisheries in the country. In the absence of reliable information about crab stocks and fishing capacity, perhaps the most pragmatic way to conserve and manage fishery resources is through the adoption of the precautionary approach.

In light of the rapidly escalating catches, crab has been expanding because of the high economic value of the species and their potential as an export commodity. China, USA, Japan, Korea and Thailand are ranked as the top five biggest consumers of crab (Breinl and Miles, 1994). Female crabs especially are playing an important role in marketing, particularly in Asian countries such as Japan, Taiwan, Hong Kong and Singapore (Keenan, 1999; Agbayani, 2001). Also, there is a growing market for mud crab meat as a value added product and for frozen soft-shelled mud crab in the USA (Keenan, 1999; Wickins and Lee, 2002). Continued increase in export of live mud crab is expected to play an important role to the foreign exchange earnings in the State if properly harnessed (Adeogun et al., 2009). The objective of this study was to assess the viability of the small-scale crab fishery and to identify the factors influencing cost structure, in order to formulate sound policies for the development of effective management of small-scale crab fisheries in Lagos lagoon. The research hypothesis tested was that there was no significant difference in the cost structure and profitability of crab fishery in the entire lagoon systems.

The study is a direct response to 'clients' need to elucidate the role crab fishing can play in poverty alleviation and national food security priorities and address the inputs required to inform these policies and future development. To the best of our knowledge, no research of any significance has been commissioned or

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conducted on economic performance of crab fishing by artisanal fishermen in Sub-Sahara Africa and therefore specific scientific literature is very limited. This is probably a combined result of the capacity of institutions undertaking agricultural studies and the emerging status of crab fishing during this period. Sustainable fishery is directly related to sustainable development of contributions of fishery, viability of fishing community, and especially positive economic performance of fishing activity. Hence, measuring the performance of a fishery's management arrangements is integral to ensuring its long term viability and sustainability and any rational and comprehensive fishery management should take into account not only biological but also cultural, political, and especially socio-economic dimensions of fishery. Similarly, Whitmarsh et al. (2000) expressed that to evaluate performance of fishery and fishery management, as well as biological information, economic data and information should have been considered. The economic indicators may be useful as an additional tool by providing criteria for a better fisheries management (Franquesa, 2001). It is intended to provide the readers with a common understanding of the economics of the fishery, and to inform discussions around potential fisheries management changes and reforms. The study intends to develop a vision for the future of these unique eco-systems and the communities that depend on them and to introduce strategies and projects to conserve their biodiversity, while developing the economic and environmental services that they provide both locally and globally.

MATERIALS AND METHODS

A multi-stage sampling technique was used in this study. This first stage involves purposive selection of all the five lagoons in Lagos state namely Badagry, Ologe, Lagos, Lekki and Epe. The second stage was the selection of 30 respondents from each of the lagoon system using simple random sampling technique. Economic assessment of the crab fishery required the collection of primary data using structured questionnaire. Data collection during 2009 and 2010 involved two major survey instruments: i) a landing survey designed to obtain information on the operating performance of fishermen; and, ii) a fishing characteristics survey aimed at identifying gear use, fishing patterns and markets. The landing survey was the principal source of costs and earning data on the artisanal fisheries, and given its importance in the present context it is necessary to explain the way it was carried out. The structure and methodology broadly followed the conventional categories and definitions of fishing expenses used in similar financial surveys (Davidse et al., 1993; Jolly and Clonts, 1993; Pascoe et al., 1997; European Commission, 2000; Whitmarsh et al., 2000; EconSearch, 2009; Ramzi, 2010), although in this case fishermen were not required to supply separate information on items such as depreciation.

However, there were two features of the survey which made it distinctive. Firstly, unlike most costs and earnings surveys which typically involve the 'one-off' collection of annual data at a specific point in time, the approach used here was to collect data twice over a period of two years. This had the advantage of allowing us to monitor the activity and performance of the fishermen as well as giving aggregate performance data. Secondly, given the reluctance of the fishermen to supply information on their sales revenue, the monetary value of production (and hence earnings) was assessed using imputed values for the commodity. These were derived by asking major customers how much they were buying the crab for.

Data analysis

In this study, to evaluate the viability of small-scale fishing operations as a commercial activity two kinds of cost were considered: real costs and theoretical (imputed) costs. Real costs are fixed and variable costs such as vessel costs, running costs. Theoretical costs are the costs that fishermen do not pay as cash such as opportunity cost, depreciation. In this study, imputed amount was estimated for the opportunity cost and as well as labour costs (it is actually real cost) due to majority of vessel owners work alone or with a family member.

Labour cost: Costs of all labour is included as theoretical cost to the total costs. For the skipper-owner an imputed amount is calculated in cases (mostly) a salary is not paid to him (Davidse et al., 1993). Crew(s) from skipper-owner's family members such as his son, wife are also included to the calculation. Therefore, minimum wages accepted by government for the year 2000 was used to estimate this cost.

Total Labour Costs = Minimum daily wage x Days at the sea x Number of crew including skipper owner

Running costs: Running costs include fuel, lubricant, and the cost of selling fish, harbour dues, the cost of bait, salt, ice, and of food and supplies for the crew.

Canoe costs: Canoe costs include canoe and gear repair and maintenance expenses.

Depreciation: Total amortization was calculated through the formula as stated:

Depreciation = Replacement value of the canoe including engine and gear - Total present value of the capital / Average age of the canoe including engine and gear.

Interest: Interest cost was considered zero due to none of the small-scale fishing vessels used bank credit.

Calculation of economic and financial performance

To assess the economic and financial performance of fishing vessels, two indicators were used. The economic performance was measured by the net cash flow (NCF), which is equal to the net profit. This was calculated as the value of landings minus all costs including the costs of depreciation and imputed interest. The NCF or net profit can be seen as the reward for entrepreneurship and expresses the absolute income of the entrepreneur or owner of the vessel. Another closely related indicator of economic performance is the NCF/total earnings (TE) ratio, which expresses the NCF or net profit as a percentage of the TE. A ratio of more than 10% can be considered as good (Tietze et al., 2005). The financial performance was measured by the NCF/investment ratio, also referred to as rate of return on investment (ROI). A level of 10% is generally considered to be a good result. The NCF or net profit expressed as a percentage of the invested capital, indicates the profitability of the investment in relation to other alternative investments (Tietze et al.,

Table 1. Socioeconomic characteristics of the crab fishers.

	Badagry (N=30)		Ologe (N=30)		Lagos (N=30)		Lekki (N=30)		Epe (N=30)		Total (N=150)	
Gender	F	%	F	%	F	%	F	%	F	%	F	%
Male	28	93.33	28	93.33	29	96.67	28	93.33	28	93.33	141	94.00
Female	2	6.67	2	6.67	1	3.33	2	6.67	2	6.67	9	6.00
Age (years)												
20	1	3.30	3	9.99	-	-	1	3.30	1	3.33	6	4.02
21-40	15	49.50	7	23.31	11	36.63	10	33.30	12	39.96	55	36.85
41-60	13	42.90	18	59.94	17	56.61	17	56.61	16	53.28	81	54.27
61	1	3.30	2	6.66	2	6.66	2	6.66	1	3.33	8	5.36
Marital status												
Single	3	10.00	4	13.33	2	6.67	2	6.67	5	16.67	16	10.67
Married	27	90.00	26	86.67	28	93.33	28	93.33	25	83.33	134	89.33
Household size												
4	8	26.67	3	10.00	5	16.67	6	20.00	7	23.33	29	19.33
5 - 8	15	50.00	16	53.33	16	53.33	12	40.00	16	53.33	75	50.00
9 - 12	3	10.00	7	23.33	7	23.33	9	30.00	4	13.33	30	20.00
No response	4	13.33	4	13.33	2	6.67	3	10.00	3	10.00	16	10.67
Experience (years)												
5	1	3.33	2	6.67	-	-	-	-	1	3.33	4	2.67
6 - 10	3	10.00	3	10.00	4	13.33	5	16.67	2	6.67	17	11.33
11 - 15	4	13.33	6	20.00	4	13.33	5	16.67	5	16.67	24	16.00
16 - 20	5	16.67	3	10.00	3	10.00	3	10.00	4	13.33	18	12.00
21 and above	17	56.67	16	53.33	19	63.33	17	56.67	18	60.00	87	58.00
Educational level (years)												
No school	12	40	6	20	1	3.33	2	6.67	8	26.67	29	19.33
Elementary	11	36.67	9	30	7	23.33	18	60	11	36.67	56	37.33
High	6	20	13	43.33	16	53.33	8	26.66	10	33.33	53	35.33
Vocational	1	3.33	2	6.67	6	20	2	6.67	1	3.33	12	8.00

2005).

Gross cash flow: Value of landings minus all cost, except depreciation and an imputed interest amount.

Net cash flow (net profit): Value of landings minus all cost, including depreciation and an imputed interest amount.

Economic performance: The economic performance was assessed through the ratio net profit/total earnings (NP/TE).

Financial performance: The financial performance was assessed through the ratio net profit/capital investment also called return on investment (ROI).

Microsoft Excel and Statistical Analysis System (SAS) for Windows were used to analyze the survey data. Inferential statistic such as Duncan Multiple Range tests were used to examine the significance of differences in economic returns among the investigated lagoons and of changes in each of the groups for the investigated issues. These tests were chosen due to the fact that they do not require a normal distribution of the data.

RESULTS AND DISCUSSION

Socio-demographic characteristics of fishermen in the study areas

The age of the crab fisher ranged between 16 and 65 years (Table 1). Average age of the respondents in all the lagoon water bodies ranged from 39.9 to 44.5 years. Most respondents from Ologe, Lagos, Lekki and Epe lagoon were within the 41 to 60 age groups while majority of the respondents from Badagry lagoon were in the 21 to 40 age bracket. Apart from Lagos lagoon which had no respondents less than 20 years of age, other lagoon had at least one respondent less than 20 years of age. Only 4.03% of the respondents are under the age of 20 years.

Overall, 91.2% of the respondents were of working age (21 to 60 years) and participate to some degree in income generating activities. More than 85% of fishermen

Table 2. Costs and returns for crab fishery in Lagos lagoon systems.

	Badagry	%	Ologe	%	Lagos	%	Lekki	%	Epe	%
Revenue (N'000)	1901.3		775.8		522.2		1,101.50		1129	
Variable costs (N'000)										
Hiring of canoe	6.47	5.26	1.04	1.05	0.89	1.12	0.466	0.44	6.47	5.59
Bait	16.15	13.14	7.14	7.22	3.56	4.49	3.006	2.84	9.2	7.94
Labour	0.11	0.09	0.25	0.25	0.1	0.13	0.1	0.09	0.00	0.00
Fuel	15.99	13.01	1.65	1.67	0.00	0.00	18.01	17.02	2.86	2.47
Basket	7.04	5.73	6.56	6.64	6.62	8.35	7.017	6.63	7.47	6.45
Transport cost of product	2.1	1.71	8.05	8.14	0.147	0.19	6.107	5.77	3.44	2.97
Personal transport	2.3	1.87	2.46	2.49	2.29	2.89	0.00	0.00	12.04	10.40
Market tax	0.7	0.57	0.43	0.44	0.33	0.42	0.00	0.00	0.34	0.29
LGA tax	0.48	0.39	1.14	1.15	0.68	0.86	0.00	0.00	1.02	0.88
Non-formal tax	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transit cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-transit cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kerosine	7.39	6.01	10.55	10.67	12.91	16.28	9.61	9.08	7.55	6.52
Food	36.86	29.99	37.67	38.11	31.72	40.01	39.31	37.16	32.42	27.99
Other costs	6.55	5.33	5.7	5.77	7.83	9.88	0.00	0.00	6.55	5.66
Total variable costs	102.14	83.09	82.64	83.61	67.08	84.60	83.626	79.05	89.36	77.15
Fixed costs ('000)										
Canoe	5.13	4.17	3.027	3.06	4.3	5.42	6.083	5.75	13.33	11.51
Lift net	3.06	2.49	2.76	2.79	7.91	9.98	0.00	0.00	0.00	0.00
Gear	11.59	9.43	10.41	10.53	0.00	0.00	15.949	15.08	13.13	11.34
Outbooard engine	1.00	0.81	0.00	0.00	0.00	0.00	0.133	0.13	0.00	0.00
Total fixed costs	20.78	16.91	16.2	16.39	12.21	15.40	22.165	20.95	26.46	22.85
Total costs (TC)	122.92		98.84		79.29		105.79		115.8	
Gross margin (Naira)	1799.17		693.15		455.1		1017.874		1039.3	
Net profit (Naira)	1778.39		676.95		442.89		995.709		1012.9	
Profitability	14.47		6.85		5.59		9.41		8.75	

in the lagoon systems were married. Over 58.0% of the respondents had more than 20 years experience in crab fishing. The education levels of survey respondents' ranged from primary school to high school. About 20% had no education while 8.0% had vocational training. None of the respondents went beyond high school. Half of the respondents interviewed had household distribution between 5 and 8 while less than 20% of the respondents were within the range of four.

Economic characteristics and viability of small-scale fishing vessels

The cost structure of small scale crab fishing in each lagoon was compared from the data collected during field studies. The different cost components of total costs, which also include cost of capital investment, are shown as percentages and distribution of main cost components are shown in Table 2. On the basis of interviews with fishers, running cost was the most important element followed by gear costs. Regarding differences in the cost structure, it can be noted that small-scale crab fishing operating in Ologe lagoon have relatively higher running costs (84.60%) than crab fishing in other lagoon systems. The analysis of variance (5.16) on operating costs of crab fishery for the entire lagoon was found to significant at 5% level.

This implies that the operating cost of crab fishery differs across the lagoon systems. Fishers in Ologe lagoon had the highest running cost which was however not significantly different from crab fishers in Lekki, Epe, and Lagos lagoons but significantly different from Badagry lagoon. Small-scale fishery is less labour intensive in all the lagoon systems. Because of low investment capacity and income level in small scale fishery, fishers prefer to go fishing alone. Moreover, some of the fishermen had no crew or went fishing with one of the family members. Food expenditure is the most important cost component of the running costs. The

highest proportion spent on food was recorded in Lagos lagoon (40.01%) while the least was in Epe lagoon (27.99%). Energy (fuel and kerosene) accounted for 8.90, 12.34, 16.28, 19.02 and 26.10% in Epe, Ologe, Lagos, Badagry and L ekki lagoons respectively. Energy consumption had been increasing and the trend is anticipated to continue and this value was even higher for fishers in Lekki lagoon. As the fuel prices move upwards, the cost of operating a crab fishery will also increase.

In contrast, crab prices have been relatively steady particularly at the local front. The com-bined effect is the potential for a reduction in the profit margin for crab fishery, especially in the Lekki lagoon area. As a result of the live baits used in all the fishing communities surveyed, cost of bait varied from 2.84% in Lekki lagoon to 13.14% in Badagry lagoon. Some of the live baits used were poultry and livestock products, dogs and rodents. The other significant cash costs were packaging materials such baskets and trans-portation. Cost of packaging varied from 5.73% in Badagry lagoon to 8.35% in Lagos lagoon. The high cost could be attributed to the replacement of the baskets. Transportation cost was higher in Ologe (8.14%) and Lekki (5.77%) lagoon systems but much lower in Lagos (0.12%) and Badagry (2.1%) lagoons. This development could be attributed to the use of canoe by the fishermen in transporting crabs to the markets. Other costs associated with crab fishing in the Lagos lagoon system include hiring of accommodation for the migrant fishermen, security, environmental cost, and accessibility to the resource. This cost ranged between 0% in Lekki lagoon to as high as 9.88% in Lagos lagoon.

Table 2 also highlights the summary of the fixed cost components of the total costs of crab fishing in Lagos lagoon system. The cost constituents were depreciation on craft (boat), gears (liftnets or nets) and outboard engine. The result shows that total fixed costs (TFC) varied from 15.40% in Lagos lagoon to 22.85% in Epe lagoon. Gear (whether liftnet or other nets) was the most important cost component of the fixed cost, accounting for 9.98, 11.34, 11.92, 13.32 and 15.08% in Lagos, Epe, Badagry, Ologe and Lekki lagoons respectively. The proportion of craft/boat to the total costs varied from 3.06% in Ologe lagoon to 11.51% in Epe lagoon. Crab fishers in only two lagoons (Badagry and Lekki) were found to be using outboard engine for operational activities. The proportion of depreciation cost for outboard engine in the two lagoon systems was less than 1.0%. The ANOVA (1.26) on depreciation cost was insignificant across the lagoon systems.

Economic and financial performance of crab fishery

The entire small-scale crab fishery in the five lagoon systems, achieve satisfactory financial and economic results. Tables 2 and 3 show that the entire fishing lagoons generated positive share income for the small-scale crab fishery. However, in terms of annual earnings (revenue), average gross margin (GM) and net profit (NP) or in other words net cash flow (NCF), costs, crab fishery vessels in study areas, Badagry, Ologe, Lagos, Lekki and Epe have positive economic results. The mean gross revenue varied from ₦522,170 in Lagos lagoon to ₦1,901,310 in Badagry lagoon. The overall mean gross revenue for the entire lagoon systems was ₦6,664,462. The difference in mean gross revenue is attributed to the difference in utilization and rates across the lagoon systems. The ANOVA shows that the means revenue for all the lagoon systems was significantly different ($F = 37.71$, $\rho < 0.0001$). This implies that level of mean revenue differs across the lagoon system. This can be attributed to catch rate and resource biodiversity. Ranked second in terms of revenue generated were crab fishers in Epe lagoon. The revenue obtained was also significantly higher than crab fishers from other lagoons except Lekki lagoon.

The mean gross margin ranges between ₦455,000 in Lagos lagoon to ₦1,799,000 in Badagry lagoon. For the net profit, crab fishers in Badagry lagoon had the highest profit of ₦1,778,390 while crab fishers in Lagos lagoon recorded ₦442,885. The F-value was 49.8 ($\rho < 0.0002$) implies that there was a significant difference in the net profit of the crab fishers across the various lagoon systems. The mean comparison shows that crab fishers in Badagry lagoon had the highest profit and significantly different from crab fishers in other lagoon systems. In terms of economic and financial performance, which is also called return on investment (ROI), crab fishery in the entire lagoon systems show positive results. ROI performance in Badagry, Epe, Lekki, Lagos and Ologe lagoon systems were 142.82, 90.6, 49.13, 49.02 and 43.03% respectively. However, crab fishery from Badagry and Epe have very good return on investment but fishers in Badagry have rather distinctive financial performance, because of their exporting activities to neighbouring countries such as Cotonou and Lome.

In studies conducted by Trietze et al. (2005), an 8 to 10 m length handliners in France have 26% ROI and 10 to 12 m length gillnetters have 8% ROI. In Norway, 10 m length gillnet handline vessels show 31% ROI, while in India, 5.5 m length, non-motorized small-scale fisheries show 163% ROI, motorized 8.3 m, and 9 to 12 m length dolnetter show 61% ROI. In another study carried out by Unal (2006) for six selected fishing cooperatives in Turkey, ROI was estimated as 43%; meanwhile, high ROI estimated in Akyaka (160%) shows similarity to ROI (163%) of non-motorized small-scale fisheries in India. However, it should be noted that ROI (43%) for the small-scale fishery in the study area is the average result and there are 59 vessels which show negative ROI among the 127. Table 2 shows comparison of these two performance characteristics of small-scale crab fishery in selected fishing communities.

Table 3. Economic and financial performance of crab fishery in Lagos lagoon systems.

Cost component	Unit	Badagry (n=30)			Lagos (n=30)			Lekki (n=30)		
		Mean	SD	CV	Mean	SD	CV	Mean	SD	CV
Gross margin	Naira ('000)	1834.9^{a}	495.05	0.27	43.4^{d}	22.30	0.51	1001.8^{b}	335.1	0.33
Total cost	Naira ('000)	66.46^{b}	57.93	0.87	13.07^{c}	5.67	0.43	99.67^{a}	380.7	0.38
Fixed cost	Naira ('000)	20.78^{ab}	22.98	1.11	12.21^{b}	6.11	0.50	22.17^{a}	20.96	0.95
Variable cost	Naira ('000)	102.14^{b}	44.79	0.95	67.08^{a}	22.37	0.32	83.63^{a}	46.67	0.60
Utilisation rate	Days fishing per year	121.3^{c}	5.07	0.04	207.6^{a}	45.59	0.22	160.0^{b}	17.89	0.11
Catch rate	Kg per day fishing	5.3^{c}	1.57	0.30	38.7^{a}	15.45	0.40	44.7a	17.75	0.40
Average price	N per kg	4031.7^{a}	457.60	0.11	98.3^{c}	14.64	0.15	145.7^{c}	13.83	0.09
Rate of return on investment	%	142.82			49.02			49.13		
Economic performance	%	93.54			84.82			90.40		

Cost component	Ologe (n=30)			Epe (n=30)			F
	Mean	SD	CV	Mean	SD	CV	
Gross margin	737.5^{c}	699.40	0.95	1022.3^{b}	629	0.62	49.8
Total cost	95.49^{a}	38.78	0.41	106.42^{a}	44.85	0.42	26.41
Fixed cost	16.20^{ab}	17.3	1.07	18.14^{ab}	22.73	1.25	1.26
Variable cost	82.64^{a}	28.89	0.35	89.36^{a}	40.13	0.45	5.16
Utilisation rate	219.3^{a}	94.86	0.43	145.6^{bc}	8.76	0.06	22.52
Catch rate	7.2^{c}	3.78	0.52	26.9^{b}	23.53	0.87	42.44
Average price	1100.7^{b}	1133.62	1.03	1253.0^{b}	2047.27	1.63	67.78
Rate of return on investment	43.03			90.6			
Economic performance	87.26			89.74			

Means with the same letters are not significantly different.

Furthermore, economic performance and ratio of total costs in total earnings are shown in Table 2. Economic performances obtained from the entire lagoon systems were very good and close. Crab fishers in Badagry lagoon had the highest performance of 93.54% and the least was 84.82% in Lagos lagoon. Others were 90.40% in Lekki, 89.74% in Epe and 87.26% in Ologe lagoon systems. Based on the methodology outlined, the study attempted to assess the extent of inter-lagoon variation in terms of the standard variation (SD) and coefficient of variation (CV). The result of the crab fishery in the various lagoon systems of Lagos State is presented in Table 3. In 2009/2010, all the crab fishermen operating in the lagoon systems earned some appreciable profits. The highest return was obtained in Badagry lagoon while the least was Lagos lagoon. Table 3 gives a clue as to the source of this divergent performance in all the lagoon systems, since it is clear that there were inter-lagoon differences in respect of utilization rates, average prices, running costs, fixed cost and other associated costs. Using benefit-cost approach as a measure of profitability, the level of profitability in Badagry lagoon was 14.47% and it accounted for 5.59% in Lagos lagoon. The high variation in fixed costs in all the lagoon systems (CV = Epe 1.25; Badagry 1.11; Ologe 1.07; and Lekki 0.95) except Lagos lagoon (CV = 0.5) was due to major repairs on boat, gears and replacement expenses incurred which could be regarded as a typical normal operating conditions.

Differences in average prices received from the sale of crab are attributable partly to differences in the mixture of sizes and sexes caught and partly

to inter-port differences in the market prices of crab and export markets. While variations in operating costs among the lagoon system may be explained to a large degree by different activity levels and inputs used (food, fuel, baits, etc.). Utilisation rates (days fishing per year), exhibited relatively low inter-lagoon variation, which is under-standable when we consider that for each fisherman the time allocated to fishing is circumscribed by seasonality, on the one hand, and the need to devote a minimum number of days to fishing in order to remain commercially viable. The ANOVA on utilization rate was 22.52 ($\rho < 0.0002$) which also imply that utilization rate varies across the lagoon systems. Variation in catch rates (CV = 0.40) are less easy to explain, but in general terms we can point to three main influences: (i) differences in density of crab stock, (ii) differences in fishing skill, and (iii) whether crab is a target specie or by-catch. F-value (42.44, $\rho < 0.0001$) for catch rate was equally significant accounting for inter-port differences in lagoon productivity, given that some ports have more favourable access to better fishing grounds, and also that attitude amongst fishermen at certain ports appear to be more entrepreneurial than others.

DISCUSSION

In terms of capitalization, the average investment of a small-scale operation (including vessel, engine and gear) varied from was N903,400 in Lagos lagoon to N1,573.300 in Ologe lagoon. Berkes (1986) stated the average investment of two man small-scale fishing vessels as US$ 4,000 for the five different fishing cooperatives in Turkey. The difference might be related to different exchange rate of Turkish Lira against the US$ or different structure of fishery, location etc. For example, average investment used by Mordogan fishermen is almost equal to that Berkes (1986) mentioned, on the other hand average investment used by Karaburun fishermen (all are part-time) is less than half of that Berkes (1986) reported.

Meanwhile, it does not mean that fishers had this amount of money in the past to invest in fishery; this is the present value of capital. In terms of economic results of the study, small scale crab fishery seemed to perform reasonably well in all the lagoon systems, but these are averages of overall economic results of fishing lagoon. The net cash flow, economic and financial performance of the crab fishers was very satisfactory.

Conclusion

This study provides a snapshot of crab fishery, using available information and data. From an economic perspective, crab fishery as a whole appears fairly healthy. However, only a single year estimate is available for crab earnings. Regardless of profitability, the crab fishing industry has an impact on the regional economy through operating expenditures, as well as income by owners and crew. It is expected that regional demand from crab fishery however, may provide employment for additional employees across various industries. From the survey, it was found that the catch rate is strongly affected by various factors including seasonality. Export of mud crabs from Nigeria is expected to rise and domestic demand needs to increase through increasing social awareness and promoting awareness of the nutritive value of this export oriented species.

Fishery does face some challenges, many of which are macroeconomic in nature, due to the high exposure that fishery has to the export market. These include exposure to fluctuations in export prices, exchange rates, and growing emphasis on eco-certification for fishery products. Considering the total export earnings from mud crabs, fishery shows future potential. To achieve this, development and support from government and different nongovernmental organizations needs to be greater and perceptions regarding the activity needs to improve for more sustainable mud crab farming and marketing in Nigeria. Having considered and interpreted the available data, the authors of this report identify priority areas for fisheries monitoring and research, which will contribute towards sustainable exploitation and management of the fishery.

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