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Determinants of Yield Performance of Culture Fish: The Case of Kainji Lake Basin, Nigeria

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Abstract

Poor agricultural reform management has resulted in dwindling fish yield along the Lake Basin in the country. To meet the ever-increasing demand for fish, fish farming as an alternative to artisanal fishery has become imperative. Hence, this paper examined how the limited variable inputs have been efficiently allocated to maximize the fish farmers' productivity level in Kainji Lake Basin, Nigeria. Stratified and simple randomized sampling technique were used to select 204 respondents from the three main strata of Kainji Lake Basin. Primary data were sourced from both literate and illiterate fish farmers. Analytical techniques employed included descriptive statistics, partial and total factor productivity and Tobit regression models. The findings revealed that most of them used earthen ponds and sourced their fingelings from private hatcheries. The most bred fish were *Clarias* and *Hetroclarias* and were mostly harvested at six or seven months. In addition, majority of the farmers sourced water from river/streams and rainfall. The mean partial productivity result revealed that labour (38.12) and lime (31.00) were better utilized than feed, fertilizer, stocking density and pond size. The mean total factor productivity index of 2.36 showed that in the overall performance assessment, fish farmers were productive in the use of their resources. The significant determinants of culture fish farmers' productivity included quantity of output ($P < 0.01$), quantity of feed ($P < 0.05$), stocking density ($P < 0.01$), labour ($P < 0.05$), educational level of fish farmers ($P < 0.10$) and access to credit ($P < 0.10$). High cost of feed and poor access to credit were the most severe constraints faced by the farmers. Based on the findings of this research, it is recommended that the Research Institute with Fresh water mandate should collaborate with skilled and adequately equipped extension agents to constantly educate the culture fish farmers on innovations in culture fish production that will improve their efficiency level.

Introduction

Agriculture is made up of four sub-activities, which encompasses crop production, livestock, forestry and fishing (NBS, 2016). The coastline of about 853 kilometres with over 14 million hectares of inland waters and an abundance of marine and brackish water resources in Nigeria delineate her potential of providing nutritional and food security for her people (Adewumi and Fagbenro, 2010). Fish production usually comes from three sources, which comprises of artisanal, aquaculture and industrial fishing. Fish farming is a sub-set of aquaculture which involves commercial raising of fish under controlled or semi controlled conditions such as tanks and fish ponds for economic and social benefits (Anthonio and Akinwumi, 2002 and Adebayo *et al.,* 2013). Its importance cannot be over emphasized as it a source of employment and livelihood for Nigerians, it increases the availability of protein improved nutrition and aids substitution of imports by local production. It also aids steady fish supply to the populace and improve the quality of fish due to improved feed and feeding. Fish is low in cholesterol, contains a wide variety of vitamins which include vitamins A, B (thiamine, riboflavin, nicotinic acid) C, D and E, and it is a source of sulphur and amino acids and is therefore suitable for complimenting high carbohydrate diets (Baruwa *et al.,* 2012). Nigeria has the largest aquaculture production in Sub-Saharan Africa making a giant stride from 21 700 tonnes in 1999 to 316 727 tonnes in 2015 (FAO, 2017). According to this report, this is made possible because Nigerian aquaculture sector is driven by the private sector coupled with renewed political will of Nigerian

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government to empower the sector in the area of aquaculture development.

The latest report revealed that 5,788,474 tonnes of fish were produced between 2010 and 2015 and that annual aquaculture production hovers around 500,000 MT per year (NBS, 2017; Raufu *et al.,* 2009). The total fish demand for Nigeria based on population estimate of 180 million is 3.32 million MT while the domestic fish production from aquaculture, artisanal and industrial fisheries put together was 1.12 million MT (FCWC, 2018) thus resulting in 2.20 million MT fish demand-supply deficit which is augmented by fish imports. According to FCWC (2018), Nigeria is a net importer of fishery products with total fish imports of about USD 1.2 billion. Therefore, there is a dire need of increasing and sustaining the production and productivity level of fish in Nigeria and especially in Kainji Lake Basin to drastically reduce the huge financial resources invested in fish import.

Productivity measures are often used to assess a country's economic performance resulting from innovation and technological change. It can be said to be the efficiency of how various inputs have been allocated in a particular enterprise. It is an average measure of the efficiency of production, which can be expressed as the ratio of output to inputs used in the production process, i.e. output per unit of input. Productivity is a crucial factor in production performance of firms and nations. Increasing the farmers' productivity can raise living standards because more real income improves people's ability to purchase goods and services, enjoy leisure, improve housing and education, helps businesses to be more profitable and contribute to social and environmental programs.

In Kainji Lake Basin (Figure 1), fish farming is an emerging enterprise supporting the livelihood of the riparian communities who largely depend on near collapse capture fisheries. Despite the current contribution of inland fisheries and its potential in national economic development, its sustainability is being threatened due to the decreasing yield, over-exploitation of natural fish stock, low level of improved technological practices, poor agricultural policy reform management and, poor economic and market infrastructure which has resulted into low productivity level. Fish yield in Kainji Lake Basin (the second most important inland fishery source in Nigeria), has declined from 32,474 MT in 1995 to 9,248 MT in 2004 (Abiodun and Niworu, 2004). Despite the nascent emergence of aquaculture in Kainji Lake Basin Area and Nigeria, it has attained rapid adoption and geometric increase in production in recent years (Chilaka *et al.,* 2014). Fish farming is profitable with good prospects in Kainji Lake Basin Area sustaining artisanal fishers who has diverted into aquaculture because of the decline in catch from the wild. Also, artisans and public servants have also shown interest in aquaculture enterprise having considered the prospect and benefits there-in. The National Institute for Fresh Water Fisheries, New Bussa has been enlightening the communities along the Lake Basin the benefits and importance of augmenting capture with culture fishery hence, the need to assess the yield performance of fish farming in the Kainji Lake Basin. It is against this backdrop that the following objectives were addressed in the study: describe the production pattern of cultured fish farmers in the study area; determine the total and partial factor productivity of the farmers and, the factors affecting the productivity of cultured fish farmers in the study area.

Materials and Methods

Kainji Lake is a reservoir on the Niger River, on the border between Niger and Kebbi States in the Northern Nigeria. It covers an area of 1250km^2 with a maximum depth of 60m and extends for 136.8km upstream of Kainji beyond Yelwa with total volume of 13.97km^3 (Olokor, 2011). It is 24.1km at its widest point (Adegbiji, 2001). According to German Technical Corporation report (GTZ, 2002), the Lake is located between Latitudes 9°50′N to 10°55′N and Longitudes 4°23′E to 4°45′E. It was primarily to generate hydro-electricity. However, it opened way for other opportunities such as irrigation farming, fisheries activities and water transportation. According to Adegbiji (2001), the dam is 1,030km from the sea, 8.3km long and 65.5m high. Thus, the birth of the dam led to the emergence of Kainji Lake Basin. The annual drawdown of water level on Lake Kainji is between 10m and 11m while the catchment area is 1.6x 10^6 km^2 and the mean annual water temperature is 27.85̊ C. Fishing communities along the lake is 297 fishing localities. German Technical Cooperation (2002) reported that 61% of the fishing localities were recorded in Niger State while 39% was recorded for Kebbi State. (GTZ, 2002). Although the main occupation of the people of Kainji Lake Basin is fishing, it is evident that capture fishing can no longer sustain the well-being of the communities around the Lake Basin following the near collapse of the lake fishery. This has forced the fishers to device alternative means of survival through fish farming. Following the huge potential and prospects of aquaculture in the study area, today aquaculture is one of the fastest expanding enterprises in the area.

Sampling technique

A three-stage sampling procedure was adopted in the selection of 204 fish farmers for this study. The first stage involved the purposive selection of Kainji Lake Basin (KLB) due to large presence of fish farmers along the Basin (Figure 2).

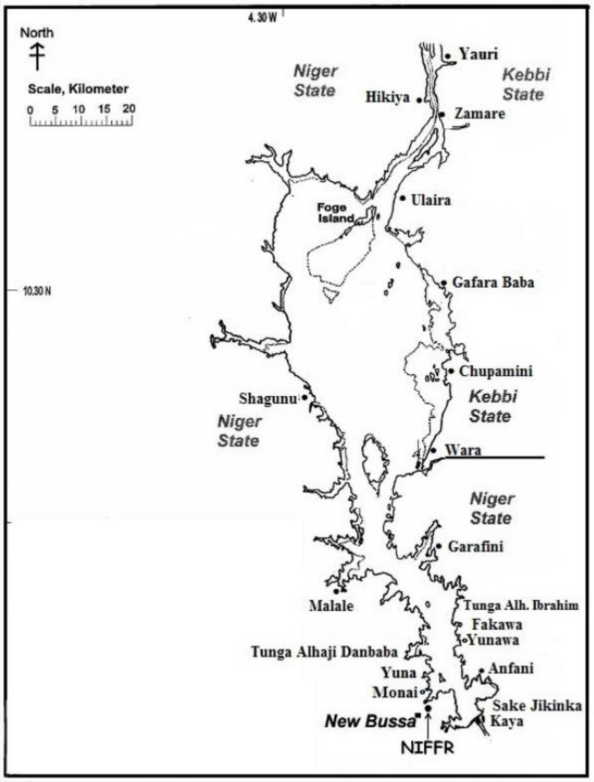

Figure 1. Map of Kanji Lake Basin showing some fish farming communities

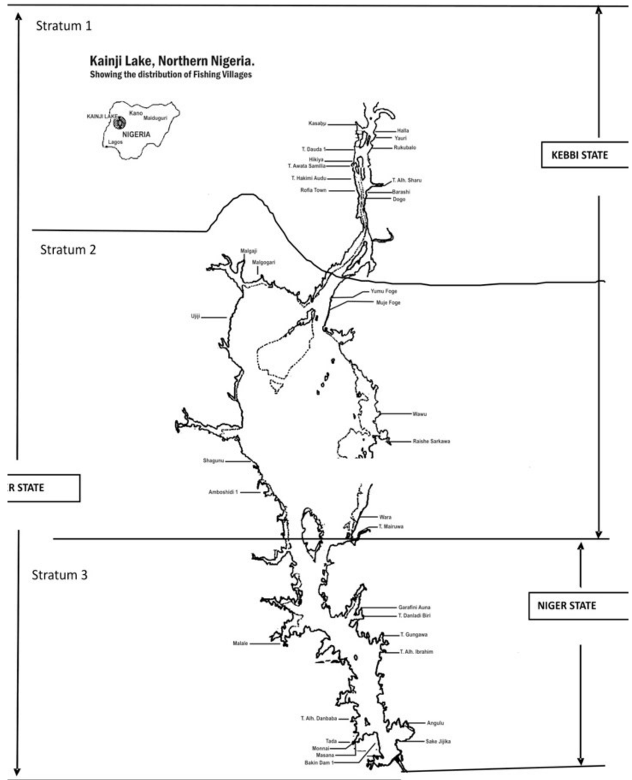

Figure 2. Map of Kanji Lake Basin showing classification of the lake area into strata

Table 1. Distribution of respondents in the study area

Stratum	Sampled Fish farming Communities	Sample Frame	Sample Size (80%)
1	Yauri	9	7
	Jijima	10	8
	Zamare	15	12
	Chulum	12	10
	Rukubalo	13	10
2	Shagunu	30	24
	TungaKwanu	20	16
	Amboshidi	10	8
	Wara	11	9
	Chupamini	13	10
3	New Bussa	25	20
	Monai	50	40
	Malale	18	14
	Yunawa	20	16
	TungaAlhajiDanbaba	10	8
	Total	266	204

Source: Field Survey, 2017

KLB is divided into three strata by the Kainji Lake Management and Conservation Unit. Hence, the second stage involved simple stratified random selection of five fishing communities from each of the three main strata of Kainji Lake Basin so as to have a clearer picture of the performance status of the fish farmers along the Basin. The third stage involved the proportionate selection of 80% of the fish farmers from each of the selected fishing communities (Table 1). Primary data were collected with the aid of personal interview and use of structured questionnaire on the socio-economic characteristics of the farmers, culture fish output, stock density, labour usage, feed consumption, fertilizer and capital inputs. Most of the farmers were educated which aided a good inter-personal relationship between the farmers and the trained enumerators.

Analytical techniques

This involved the use of descriptive and econometric analyses. Descriptive statistics were used to identify the various production pattern and the summary statistics of culture fish farming in the area. Productivity index and ordinary least square models were used to address the technical efficiency, productivity and determinants of culture fish farmers' productivity in the area.

Productivity Indices of the farmers

Analysis of the determinants of productivity of culture fish farmers in this study involved two stages. The first stage involved generating the Productivity Index (PI) while the second stage involved the use of Tobit regression to analyze the determinants of productivity of culture fish farmers in the area. The partial factor productivity index was used to estimate the productivity of each of the various farm inputs used by the fish farmers in the study area. The formulae used was adopted from Mohammad (2017) and modified by the researcher thus:

Pond size productivity (Yield) = $\frac{Total\ fish\ output}{Total\ pond\ size\ used}$

Feed productivity = $\frac{Total\ fish\ output}{Total\ Feed\ used}$

Labour productivity = $\frac{Total\ fish\ output}{Total\ Labour\ used}$

Fertilizer productivity = $\frac{Total\ fish\ output}{Total\ fertilizer\ used}$

Lime productivity = $\frac{Total\ fish\ output}{Total\ lime\ used}$

The TFP of the cultured fish farmers in the study area as used by Mohammad (2017) was adopted and expressed in equation 6.

Total Factor Productivity (TFP) $\frac{VOP}{VIE} = \frac{VOP}{TVC}$

Where, VOP= Value of Output (₦); TVC = VIE = Value of Inputs Employed (₦)

Determinants of productivity of culture fish farmers

The scores generated were fitted into Ordinary Least Square regression model as the dependent variable, Y. The model is implicitly specified as follows:

TFP=f(QUF, STD, LAB, LIM, FER, CAI, AGE, SEX, EDU, FEX, CRA, FEC

Where, TFP = Total factor productivity index; QUO = quantity of output; QUF = Quantity of feed (kg); STD = Stock density (Number of fingerlings); LAB = Labour (Man-day); LIM = Lime (kg); CAI = Capital input (₦); AGE = Age (Years); SEX = Sex (Male = 1, female = 0); EDU = Education (Years); FEX = Farmer experience in fishing (Years); CRA = Credit access (₦); FEC = Frequency of contact with extension agents (No.)

Results and Discussion

Production pattern of the cultured fish farmers

Fish farming is a labour-intensive bio-industry characteristically organized into categories depending on its intensification. There are various production pattern fish farmers could adopt subject to availability of infrastructure and cash as well as the level of technical know-how of the farmer. Fish culture system involves raising fish commercially in tanks or enclosures, usually for food. The result in Table 2 showed that 84.8% of the culture fish farmers used intensive culture system of fish production because they were cultured for commercial purposes and intensive culture system will facilitate the growth rate and early maturity of fish. Only 10.3% of the fish farmer operated on semi- intensive culture system while 4.90% of the fish farmers adopted extensive system of fish culturing. Cultured fish farmers as indicated in the Table adopted different fish culture practices. For instance, about half (54.9%) of the fish farmers in the study area adopted poly-culture practice of fish culture. Poly-culture as defined by Ovie and Ovie (2010) is the culture of two or more fish species together in a pond. The reason for the high percentage could be because it is advantageous in the utilization of all available food resources. Monoculture type of fish culture was also adopted by 37.7% of the fish farmer while 3.9% and 3.43% fish farmer practiced mono-sex and integrated practices, respectively.

Table 2. Production patterns of cultured fish farmers in the study area

Variables	Frequency	Percentage
Culture system		
Extensive	10	4.90
Semi- intensive	21	10.3
Intensive	173	84.8
Total	204	100.0
Culture practices		
Monoculture	77	37.7
Mono-sex	8	3.9
Poly culture	112	54.9
Integrated	7	3.43
Total	204	100.0
Species cultured		
Tilapia	24	11.76
*Clarias (*Indigenous breed*)*	149	73.04
Hybrid (*Hetroclarias*)	100	49.02
Heterobranchus	43	21.08
Sources of fingerlings		
Private Hatchery	182	89.22
Wild	32	15.69
Self breeding	26	12.75
Govt. Institution	4	1.96
Others (from Friend)	1	0.49
Sources of water		
Stream/ River	153	75.0
Tap	16	7.84
Underground borehole	45	22.0
Rainfall	116	58.9
Deep Well	25	12.25
Rearing structure		
Earthen Pond/ Concrete	29	14.22
Concrete pond Only	3	1.47
Earthen Pond Only	174	85.3
Fish Trough	2	0.98
Culturing period		
Four Months	3	1.47
Five Months	14	6.86
Six Months	146	71.6
Seven Months	38	18.6
Eight Months	2	0.98
Nine Months	1	0.49
Types of feed used		
Imported with Local	187	91.6
Local only	13	6.37
Imported Only	2	0.98
Household waste	2	0.98
Total	204	100.0

Source: Field Survey, 2017

The guiding principle in the selection of cultured fish species include: growth rate of the fish, short food chain of the species, good table quality as well as readily available market which is a function of their demand. As revealed in Table 2, majority (73.04%) of the fish farmers in the study area cultured *Clarias* Species which agrees with Agboola (2011) in a study conducted on improving fish farming productivity towards achieving food security in Osun State, Nigeria. The study revealed that most farms in Osun State raised *Clarias spp.* alone which was also affirmed by a study by Adewumi and Olaleye (2011) on catfish culture in Nigeria: progress, prospect and problems and reported that 82.3% of cultured fish species reared in Nigeria were *Clarias spp*. followed by Hybrid (*Hetroclaris*), 49.02% while, 21.08% and 11.76% fish farmers reared *Hetrobranchus* and Tilapia species, respectively.

The availability of fingerlings within reach is of economic importance in fish farming enterprise because fingerlings are production factor which can either be hatched by the farmer or purchased from other sources. The distribution from Table 2 revealed that majority (89.2%) sourced their fingerlings from private hatcheries due to the availability of brood stock coupled with the training private hatcheries operators received from the government through the National Institute for Freshwater Fisheries Research (NIFFR), New-Bussa. About 13% of the farmers bred the fingerlings themselves which is a welcome development. It is believed that the percentage of farmers engaged in breeding of the fingerlings would increase in the future as more training are extended to the farmers through extension agents and/or NIFFR. This will reduce the number of farmers (16%) who sourced their fingerlings from the wild and hence improve the yield of the fish and productivity of the farmers in the area. The discovery in the study area agrees with the findings of Agboola (2011) that most fish farmers in Osun State, Nigeria sourced their fingerlings from private farms. Table 2 revealed that majority 75% of the fish farmer in the study area made use of river and stream water probably because the study area was Kainji Lake Basin, Nigeria which shared boarder with River Niger. Also, 58.9% of the fish farmers augmented water supply with rainfall. 22.0% of the farmers made use of underground borehole as source of water while 12.3% and 7.84% made use of deep well and tap water, respectively.

As shown in Table 2, it was discovered that majority (85.3%) of the culture fish farmers in the study area subscribed to earthen pond rearing structure only which could be as a result of the high water retention ability of soil in the area as well as consumers' preference for fish raised in earthen pond due to its peculiar sweetness than fish raised in concrete or fibre tanks. The findings in the study area confirmed the findings of Adebayo and Daramola (2013) on Economics analysis of catfish production in Ibadan metropolis, Nigeria that majority of fish farmers in Ibadan metropolis made use of earthen pond structure for fish production. Furthermore, 14.2% of the fish farmer in the study area made use of earthen/concrete pond for the culturing activities while 1.47% and 0.98% made use of concrete and fish trough, respectively. Maturity of fish depends not only on the type of feed but also on the breed used in stocking. Table **2** further revealed that 71.6% of the fish farmer in the study area reared their fish for a period of six months due to the fact that *Clarias spp* possesses the quality of high growth rate when properly fed and can adapt favourably compare to other species of fish reared in confinement. However, 18.6% of the fish farmers in the study area reared their fish for seven month, 6.86% rear their fish for five month, 1.47% rear their fish for four month while 0.98% and 0.49% of the fish farmers in the study area reared their fish for the period of eight and nine month respectively. Moreover, 91.6% of the fish farmers in the study area introduced imported (Extruded) feed like aqua-feed, copeens with locally formulated feed to feed their fish. This could be because imported (Extruded) feed can be use to boost the growth of fish at their fry/fingerlings stage However, locally formulated feed was introduce to compliment imported feed because of the high cost of imported feed. Furthermore, 6.37% of the fish farmers in the study area used local feed alone while imported feed and household waste of 0.98% respectively were used by the fish farmer to feed the fish in the study area.

Summary statistics of the production variables

Analysis of summary statistics of the various inputs used was as revealed in Table 3. The Table showed an average 4379.12kg of feed was used per farmer. The average stocking density of 2560 fingerlings per farmer indicated high stocking density in the study area. The average labour of 76.37 man-day per farmer showed that fish farmer in the study area relied heavily on human labour to do most of the fish farming operations. The analysis also showed that lime, fertilizer and capital input had mean values of 1.53kg/farmer, 2.99kg/farmer, and ₦4921.81/farmer, respectively.

Productivity analysis of cultured fish farmers

Measurement of productivity is one of the key elements of assessing yield performance; the standard of living of the farmers and identifying real cost savings and possible inefficiencies in production (Organisation for Economic Co-Operation and Development (OECD), 2001). It involves the continual application of new methods and techniques into production to enhance the ability of a better performance in the future.

Partial factor productivity of cultured fish farmers

Partial productivity measures could be more informative than total factor productivity because it assists in the assessment of the efficiency of the use of specific resources used in production. The results of partial factor productivity indices of inputs such as pond, feed, labour, lime, fertilizer and capital inputs were presented in Table 4. Among all the partial productivity measure, labour productivity is very important because it is a unique and dynamic measure of economic growth, competitiveness, and living standards within an economy. The result revealed that the mean partial productivity of labour and pond size, fertilizer and capital input were all greater than one. These values implied that the farmers were productive in the use of the available resources at their disposal. Hence, the production factors contributed to the productivity level of culture fish farmers in the study area. On a closer look, lime, fertilizer and labour had maximum values of 556, 440 and 114.28, respectively. Moreover, labour (MP = 38.12) and lime (MP = 31.00) were better utilized than feed, fertilizer, stocking density and pond size. The least utilized input in the area was feed with MP value of 1.22. This was closely followed by stocking density with MPP value of 1.67. The standard deviation of pond size, stocking density and feed were low while that of lime was unusually large. In addition, the results revealed that there were some fish farmers who did not apply fertilizer nor lime in their fish production. The total factor productivity (TFP) of 2.36 showed that in the overall performance assessment, fish farmers were productive in the use of their resources though there is still room for improvement in the future. According to Zelenyuk (2014), increasing the farmers' productivity translates to improving the well-being of the farmers and their households through improved living standards because more real income improves people's ability to purchase goods and services, enjoy leisure, improve housing and education and contribute to social and environmental programs of a country.

Determinants of culture fish farmers' productivity

The Tobit regression result of analysis of the factors affecting fish farmer productivity in the study area was presented in Table 5. The result indicated F-value of 2.90, which showed that the whole model was statistically significant at 1% level of probability. The robust of Tobit result showed that six out of the eleven included predictors were significant at various degree of probability level.

Table 5 further revealed that quantity of output, labour, educational level and amount of credit accessed were positive and significant at $P < 0.01$, $P < 0.05$, $P < 0.10$ and $P < 0.10$ levels, respectively. This revealed that an increase in each of these variables will lead to increase in the productivity of the fish farmers in the area. On the contrary, quantity of feed and stocking density were negative but significant at $P < 0.05$ and $P < 0.01$ levels, respectively. This depicts an inverse relationship with productivity of the farmers. This could occur if the cost of feed is too high and, the pond is over or under stocked. This agrees with the findings of Mohammad (2017) who reported that farming experience, labour, planting material were the main determinant of food crop farmers' productivity in North East, Nigeria.

Constraints faced by cultured fish farmers

The constraints limiting the production and productivity of the cultured fish farmers was as shown in Table 6. The findings revealed that high cost of feed ranked first as the most severe constraint faced by cultured fish farmers with a mean value of $\bar{x} = 4.4$ in the study area. This was followed closely by inadequate credit of $\bar{x} = 3.9$, poor remunerative prices of $\bar{x} = 3.7$, unavailability of production inputs of $\bar{x} = 3.6$ and inadequate availability of improved fingerlings which ranked 2^{nd}, 3^{rd}, 4^{th} and 5^{th}, respectively. However, incidence of pest $\bar{x} = 2.6$, inadequate extension agent visit $\bar{x} = 2.3$, low dissemination of research findings $\bar{x} = 2.3$, insufficient water $\bar{x} = 2.2$, and adverse climatic condition $\bar{x} = 2.0$, among others were considered not severe constraints by the fish farmers. These constraints had hindered the efficiency level of the cultured fish farmers in the study area. This result corroborated the findings of Adebayo and Daramola (2013) in their research report on the analysis of catfish production in Ibadan metropolis that inadequate access to credit facilities limited their production with a mean value of 3.9. It was also in agreement with the findings of Agboola (2011) who reported that finance was a constraint to improving fish farmers' productivity towards achieving food security in Osun State, Nigeria.

Table 3. Summary statistics of the variables in the model

Variables	Mean	Standard deviation	Minimum	Maximum
Feed (kg)	4379.12	1644.74	1400.00	9600.00
Stock density(No)	2560.00	817.64	500.00	4750.00
Labour(Man-day)	76.37	73.89	3.00	501.00
Lime (kg)	1.53	6.09	0.00	50.01
Fertilizer (kg)	2.99	11.19	0.00	75.01
Capital input (₦)	4921.81	2117.01	1057.15	18660.01

Source: Field Survey, 2017

Table 4. Partial and total factor Productivity of culture fish farmers in the study area

Variables	Mean productivity (MP)	Standard deviation	Minimum	Maximum
Pond	3.30	1.39	1.02	16.00
Stock density	1.67	0.95	0.40	5.35
Feed	1.22	0.44	0.11	2.76
Labour	38.12	23.65	3.17	114.28
Fertilizer	13.03	59.74	0.00	440.00
Lime	31.00	101.79	0.00	556.00
Total Factor Productivity	2.36	0.91	1.05	6.99

Source: Field Survey, 2017

Table 5. Determinants of fish farmers' productivity in the study area

Variables	Coefficient	Std. Error	t – value
Quantity of Output (QUO)	0.10170	0.03555	2.86***
Quantity of Feed (QUF)	-0.00006	0.00003	- 2.08**
Stock Density (STD)	-0.00030	0.00011	- 2.65***
Labour (LAB)	0.00169	0.00066	2.54**
Lime (LIM)	-0.00013	0.00047	- 0.27
Capital Input (CAI)	-0.00000	0.00002	- 0.18
Age (AGE)	-0.00426	0.00631	- 0.67
Sex (SEX)	0.09729	0.11424	0.85
Educational Level (EDU)	0.02181	0.01195	1.83*
Farmers Experience (FEX)	0.01180	0.01051	1.12
Credit Access (CRA)	0.00000	0.00000	1.66*
Log Pseudo Likelihood	-186.895		
F(11, 193)	2.90		
Prob > F	0.0015		
Pseudo R2	0.0624		

Source: Field Survey, 2017; *** implies Significant at P < 0.01 level of probability, ** implies Significant at P < 0.05 level of probability, * implies Significant at P < 0.10 level of probability

Table 5. Constraints faced by cultured fish farmers in the study area

Variable	Weighted Sum	Weighted Mean Score	Rank	Remarks
High Cost of Feed	898	4.4	1st	Severe
Inadequate Access to Credit	812	3.9	2nd	Severe
Poor Remunerative Prices	755	3.7	3rd	Severe
Unavailability of Production Inputs	740	3.6	4th	Severe
Inadequate Improved Fingerlings	626	3.0	5th	Severe
Incidence of Pest	531	2.6	6th	Not Severe
Inadequate Extension Agent	477	2.3	7th	Not Severe
Low Dissemination of Research Findings	474	2.3	8th	Not Severe
Insufficient Water	467	2.2	9th	Not Severe
Adverse Climatic Condition	423	2.0	10th	Not Severe
Pilfering/ Theft	389	1.9	11th	Not Severe
Inadequate Labour	401	1.9	12th	Not Severe
Land /Pond Acquisition Problem	308	1.5	13th	Not Severe
Flooding	257	1.2	14th	Not Severe

Source: Field Survey, 2017

Conclusion

Based on the findings of the study, it is concluded that majority of the farmers subscribed to earthen pond rearing structure and sourced their fingerlings from private hatcheries. The most bred fish were *Clarias* and *Hetroclarias* and were mostly harvested at six or seven months. In addition, majority of the farmers sourced water from river/streams and rainfall. The mean partial productivity result revealed that labour (38.12) and lime (31.00) were better utilized than feed, fertilizer, stocking density and pond size. However, feed productivity was the least with mean value of 1.22 while labour productivity was highest with mean value of 38.12. The mean total factor productivity index of 2.36 showed that in the overall performance assessment, fish farmers were productive in the use of their resources. The significant determinants of culture fish farmers' productivity included quantity of output, quantity of feed, stock density, labour, educational level of fish farmers and access to credit. The most severe constraint was the high cost of feed. Based on the findings of this research, it is therefore recommended that fisheries policies aimed at improving, encouraging and promoting fish production in the Kainji Lake Basin should be established, implemented and monitored in order to increase efficiency which in turn will increase the level of fish sufficiency among Nigerians. Also, the Research Institute with Fresh water mandate should collaborate with skilled and adequately equipped extension agents to constantly educate the culture fish farmers on innovations in culture fish production that will improve their efficiency level. In addition, further research on cultured fish farming particularly in Kainji Lake Basin, should focus on deriving optimum production plans for the farmers. This will provide valuable production guide to existing and intending fish farmers towards efficient allocation of available production inputs, which will enhance increased yield and productivity.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

References

Abiodun, J. A. and Niworu, A. M. 2004. Fisheries statistical bulletin kainji lake, Nigeria. Kainji Lake Fisheries Management and Conservation unit. Technical report series. 1-23.

Adebayo, O. O. and Daramola, O. A. 2013. Economic analysis of catfish (Clarias gariepinus) production in Ibadan metropolis. Discourse Journal of Agriculture and Food Science, 1 (7): 128 – 134.

Adegbiji, J. A. 2001. Investigating public relations as agent in fishermen adoption of fisheries edict in kainji lake basin, Nigeria. Unpublished master's thesis. University of Ibadan. Oyo State, Nigeria. 37-38.

Adewumi, A. A and Fagbenro, A.O. 2010."Fisheries and aquaculture development in Nigeria: An appraisal." International Conference on Bioinformatics and Biomedical Technology, Chengdu, pp. 423-426. doi: 10.1109/ICBBT.2010.5478927

Adewumi, A. A. and Olaleye, U. F. 2011. Catfish culture in Nigeria: progress, prospects and problems. African Journal of Agricultural Research, 6 (6), 1281 – 1285.

Agboola, W. L. 2011. Improving fish farming productivity towards achieving food security in Osun State, Nigeria: Socio-economic analysis. Scholars Research Library, Annals of Biological Research, 2 (3): 62 – 74.

Anthonio, O. R. and Akinwumi, J. A. 2002. Supply and distribution of fish in Nigeria. Geographical Journal, 14: 16-16.

Baruwa, O. I., Tijani, A. A. and Adejobi, A. O. 2012. Profitability and constraints to fishery enterprises: A case of artisanal and aquaculture fisheries in Lagos State, Nigeria. Nigerian Journal of Agriculture, Food and Environment, 8(1): 52-58.

Chilaka, Q. M., Nwabeze, G. O. and Odili, O. E. 2014. Challenges of inland artisanal fish production in Nigeria: Economic perspective. Journal of Fisheries and Aquatic Science, 9 (6): 501 – 505.

Food and Agriculture Organization, 2007-2018. Fishery and Aquaculture Country Profiles. Nigeria (2007). Country Profile Fact Sheets. In: FAO Fisheries and Aquaculture Department [online]. Rome. [Cited 31 July 2018]. http://www.fao.org/fishery/

FCWC, 2018. Fishery Committee for the West Central Gulf of Guinea. A Report of the 10th session Conference of Ministers of the Fisheries Committee for the West Central Gulf of Guinea held in Abuja, Nigeria on 15th December, 2017

GTZ, 2002. German Technical Cooperation (GTZ). Kainji Lake Fisheries Promotion Project. Fishery Statistical Bulletin, Kainji Lake, Nigeria.Technical Report Series.

Kainji Lake Management Cooperation Unit (KLMCU) 2002. Kainji Lake Fisheries Promotion Project. Fishery Statistical Bulletin, Kainji Lake, Nigeria

Mohammad, A. U. 2017. Effect of insurgency on food crops farmers' productivity in North East Nigeria. Unpublished MTech Thesis, Department of Agricultural Economics and Extension Technology, Federal University of Technology, Minna Nigeria: p 4-19

NBS, 2017. National Bureau of Statistics. Nigeria's Fish production (2010-2015) www.nigerianstat.gov.ng

NBS, 2016. Nigerian's Gross Domestic Product www.nigerianstat.gov.ng

Olokor, J. O. 2011. Geography and Climate of Kainji Lake Basin; Forty years on Lake Fishery Research, 6 – 8.

Ovie, S. O. & Ovie, S. I. 2010. Aquaculture in Focus. Remi- Thomas Prints, 119 Upper Gaa-Akanbi Road, Ilorin, Kwara State. ISBN: 978-177-068-6

Raufu, M. O., Adepoju, A. A., Sakau, A. S., and Adebiyi, O. A. 2009. Determinants of yield performance in small scale fish farming in Alimosho Local Government Area of Lagos State. International Journal of Agricultural Economics and Rural Development, 2 (1): 245 – 256.

Zelenyuk, V. 2014. "Testing significance of contributions in growth accounting, with application to testing ICT impact on labor productivity of developed countries". International Journal of Business and Economics 13(2): 115-126.