Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 22, Issue 1, 2022
PRINT ISSN 2284-7995, E-ISSN 2285-3952

EFFECTS OF MACRO-ECONOMIC VARIABLES ON FISHERIES SUPPLY IN NIGERIA (1980-2019)

Ahmed Olugbenga BUSARI[1], Abolupe Oluyemi AYANBOYE[2]

[1]Osun State University, Faculty of Agricultural Production and Management, College of Agriculture, Ejigbo Campus, Department of Agricultural Economics and Agribusiness Management, Phones: +2348052174096, +2348037860000; E-mail: hamed.busari@uniosun.edu.ng, kehindeal@uniosu.edu.ng
[2]Osun State University, Faculty of Renewable Natural Resources, College of Agriculture, Ejigbo Campus, Department of Fisheries and Aquatic Resources Management, Phones: +2349055353133; E-mail: oluyemi.ayanboye@uniosun.edu.ng

Corresponding author: hamed.busari@uniosun.edu.ng

Abstract

Fish is an important source of animal protein in Nigeria. The per capita consumption of fish in Nigeria has suffered a serious decline in the recent years due to declining production. The study investigated the macro-economic determinants of fisheries supply in Nigeria between 1980 and 2019. Secondary data spanning 39 years (1980 – 2019) were sourced from reputable organizations. Food and Agricultural Organization database (FAOSTAT) Nigeria Bureau of Statistics (NBS) and Central Bank of Nigeria (CBN) Data were analyzed using mean, percentages coefficient of variation, Augmented Dickey-Fuller statistics, Johansen Co-integration and vector error correction model (VECM) result of statistical analysis revealed that variable of the model was stationary after first difference with co-integration among the variable Descriptive results shows the fluctuation in the agriculture capture fisheries and total fisheries supply over the study period with a mean of 88,890.48 tonnes, 453,278.80 tonnes and 547,043.50 tonnes respectively average annual growth rate of agriculture capture fishery and total fishery production were 502.42 percent, 187.98 percent, and 298.59 percent respectively. VECM results revealed that population has an asymmetric effect on total fishery supply in the short and long run. However, exchange, interest, and inflation rate negatively influence fishery supply, the study concludes that population, exchange, interest, and inflation rate significantly influence total fisheries supply in the study area. Thus, it is recommended that there is a need for significant improvement in aquaculture production and reduction in fish importation to cushion the effect of exchange, inflation, and interest rate on the economy.

Key words**:** *domestic fish supply, domestic fish demand, exchange and inflation rates, error correction mechanism*

INTRODUCTION

Fish is very important to nutrition among Africa populace [5]. Maintaining the required levels of animal-sourced protein is an important factor in fighting malnutrition among the populace, especially children in Africa [10]. Africa generally as a continent is confronted with acute food shortage and malnutrition problems [2], and fish is one of the most sourced animal protein across the African continent [6]. The situation is not different in Nigeria where there is a high prevalence of malnutrition and fish is of the most sourced animal protein food sources. [12], [16] and [13]. As in other developing coastal nations, especially in West Africa, Nigeria recorded a high prevalence of micro-nutrients deficiencies among children, in spite of the fact that 20% of the current fish catches can supplement children's nutrient requirements [11] and [3].

The fishing industry in Nigeria comprises of three major sub-sectors; artisanal, industrial, and aquaculture which has the full potential of augmenting significantly, the domestic fish production and supply in the country [1].

The amount of fish or other aquatic organisms consumed as food that consumers in Nigeria are willing and are able to buy annually at a particular price is known as the demand for fish in Nigeria. The amount of fish or other aquatic organisms consumed as food that is produced and made available for consumption and utilization domestically is known as fish supply [15]. Fish supply in

Nigeria currently comes through two major sources; the capture fishery (capture) and aquaculture fishery (aquaculture) [7], [8] and [15]. The total amount of fisheries resources that are harvested by the state from all available extensive sources as the aggregate of all fishing effort in terms of manpower, time, gears, and trawlers directed into harvesting fresh water and marine fisheries over a one year period is known as fish capture. Fish capture is therefore independent of harvested fishery resources from aquaculture sources. Aquaculture fishery is made up of fish that are cultivated or farmed in controlled, enclosed, and or confined freshwater or brackish ponds, and they are harvested for consumption or for income generation at maturity [17].

The difference between the demand for fish and fish supply is fish demand-supply gap, which can be a surplus, when supply is higher than demand or a deficit, when demand is higher than supply) [15].

According to the [14]. In 2014, Nigeria population is estimated at 180 million people, demand for fish is estimated at 3.32 metric tonnes, domestic fish production and supply from aquaculture, artisanal and industrial fisheries us estimated at 1.12 metric tonnes, creating a demand-supply gap of 2.20 metric tonnes which is met through fish importation. Also in 2014, the contributions of fisheries to Agriculture Gross Domestic Product (Ag GDP) were 0.48% and 20.24% respectively.

Furthermore, the [8] and [9] reported that Nigeria currently produces about a 0.8million metric tonnes of fish annually, with domestic annual demand estimated at 2.7 million tonnes, resulting in a deficit of 1.9 million metrics tonnes of fish, which is supplemented through annual importation of $1.2 billion worth of fish into the country. Currently, Nigeria is the fourth leading importer of fish in the world, behind China, Japan, and the United States [3]. This incessant importation of fish signifies an enormous loss of foreign exchange earnings to Nigeria which is detrimental to economic growth and development [17 and [15].

Nigeria is blessed with a vast amount of inland water bodies and gasoline estimated at 800 km and providing means of livelihood to about 1.5 million people who are engaged in fish-based livelihoods [9], [19] and [2]. The output of Nigeria's fisheries is estimated at one million tonnes of fish per annum, with capture fisheries supplying over 750,000 tonnes and about 310,000 tonnes are produced from aquaculture fisheries. [19] and [3]. Despite being blessed with a coastline of Atlantic Ocean measuring about 853 kilometres, and other water resources such as freshwater bodies, mangrove swamps, coastal rivers, creeks, onshore and offshore, waters, bays, and estuaries, it is not clearly understood why Nigeria still supplemented her domestic fish demand through fish importation. Eight out of thirty-six Nigerian states, with 25% of the total population of Nigeria are surrounded by the coastline of the Atlantic Ocean; a major fishing resource of the world. Yet, domestic demand for fish is more than domestic production and supply,, resulting in a huge supply-demand deficit.

In view of the above, the study investigated the effects of macro-economic variables on fisheries supply in Nigeria over the study period (1980 – 2019). The study examined trends in aquaculture production, capture fisheries production, total fisheries production, and the influence of macro-economic variables on fisheries supply in Nigeria during the study period (1980 – 2019).

MATERIALS AND METHODS

The research was conducted in Nigeria. With about 186 million people in 2014, Nigeria is the country with highest population in Africa [4], [19] and [3], and it continues to grow steadily each year. From 2010 to 2016, Nigeria's population grew an average of 17% annually [18]. The data for this research were in annual time series. The data set was obtained from secondary sources. These sources included publications of the Central Bank of Nigeria (CBN), the National Bureau of Statistics (NBS), and Food and Agriculture Organization (FAO) Statistics (FAOSTAT). Data were collected specifically on capture fisheries supply, aquaculture supply, total fisheries supply, gross domestic product

(GDP), population, interest rates, inflation rates, and exchange rate. Data analysis covers the period between 1980 and 2019.

This study took advantage of a number of analytical methods based on the previously stated objectives of the study. These include; means, standard deviation, coefficients of variation, percentages, and average growth rate. These statistical tools were used to describe trends in aquaculture supply, capture fisheries supply, and total fisheries supply.

The Augmented Dickey-Fuller statistics were used to examine the stationary of time series data. The Johansen's method was employed in verifying co-integration among the variables of the model. The vector error correction model (VECM) was employed as a tool to investigate the macro-economic determinants of fisheries supply over the study period. The implicit model employed in this study is specified as follows:

$$\Delta LnY_t = \alpha_1 + \alpha_2 \Delta lnY_{t-1} + \alpha_3 \Delta lnX_{2t-1} + \alpha_4 \Delta lnX_{3t-1} + \alpha_5 \Delta lnX_{4t-1} + \alpha_6 \Delta lnX_{5t-1} + \lambda_1 ECT_{t-1} + u_{t1} \quad (1)$$

where:

Y is the total fisheries supply in thousands metric tonnes;

X_1 is the GDP valued in USD;

X_2 is the population in millions people;

X_3 is the exchange rate measured as amount of Naira exchanged for USD;

X_4 is the interest rate in the economy measured in percentage;

X_5 is the inflation rate in the economy measured in percentage;

ECMt is the error correction factor.

Δ is the difference operator;

$_{t-1}$ is the lagged values of variables;

Ln is the logarithm operator;

U_{ts} are stochastic random errors;

α_1, α_2, α_3, α_4, α_5, α_6, and λ_1 are parameters to be estimated.

RESULTS AND DISCUSSIONS

Trend in aquaculture production in Nigeria (1980-2019)

Table 1 and Figure 1 present the trend in aquaculture production in Nigeria between 1980 and 2019. From the table, aquaculture production fluctuated over the study period. Average aquaculture production ranged from 8,805.20 tonnes in the 1980-1989 sub-period and 2,615,641.60 tonnes in the 2010-2019 sub-period, showing an increasing trend in aquaculture production during the study period. The average aquaculture production over the study period was 88,890.48 tonnes. However, the highest average annual growth rate (328.61%) in aquaculture was recorded in the 1980-1989 sub-period and the lowest annual growth rate (54.03%) in the 2010-2019 sub-period. The intra sub-periods coefficients of variation ranged from 14.16 percent in the 2000-2009 sub-period and highest of 37.82 percent in the 1990-1999 sub-period, with an average of 129.22% over the period of the study, showing a high degree of instability.

Table 1. Trends in aquaculture production (tonnes) in Nigeria

Sub-period	Annual percent growth rate	Annual percentage change	Coefficient of variation
1980-89	259,703.00	7.58	250.07
1990-99	336,130.90	47.46	42.37
2000-09	512,049.50	35.53	11.83
2010-19	705,232.00	19.15	6.81
All periods (1980-2019)	453,278.80	187.98	40.13

Source: Computed from FAOSTAT, NBS and CBN Statistical Bulletin, 2021.

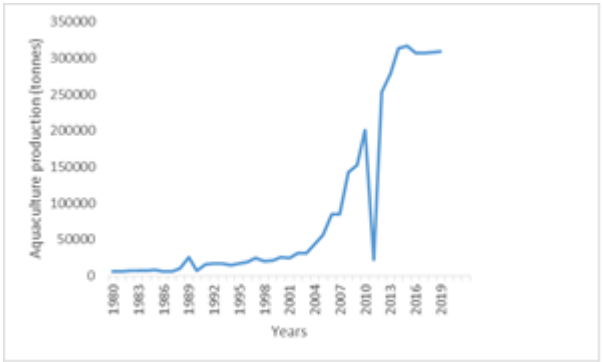

Fig. 1. Trends in aquaculture production (tonnes) in Nigeria (1980-2019)
Source: Authors' computation, 2021.

Trend in capture fisheries production (tonnes) in Nigeria (1980-2019)

Table 2 and Figure 2 present the trend in capture fisheries production in Nigeria between 1980 and 2019. From the table, average capture fisheries production increased

progressively across the sub-periods, ranging from 259,703.00 tonnes in the 1980-1989 sub-period to 705,232.00 tonnes in the 2010-2019 sub-period, with a mean of 453,278.80 tonnes over the study period. The average annual growth rate of capture fisheries production alternately decreases and increases during the entire study period, with an all-period mean of 187.98 percent. The intra sub-periods coefficients of variation ranged from 6.81 percent in the 2010-2019 sub-period to 250.87% in the 1980-1989 sub-period, with an average of 40.13 percent over the period of the study, reflecting a high degree of instability in capture fisheries production.

Table 2. Trend in capture fisheries (tonnes) in Nigeria (1980-2019)

Sub-periods	Mean	Annual percent growth rate	Coefficients of variation
1980-89	8,805.20	328.6066	14.29
1990-99	17,452.20	195.86	37.82
2000-09	67,742.90	494.12	14.16
2010-19	2,615,641.60	54.03	28.54
All Periods	88,890.48	502.42	129.22

Source: Computed from FAOSTAT, NBS and CBN Statistical Bulletin, 2021.

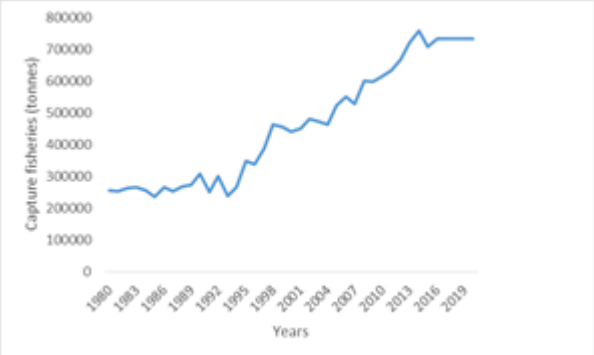

Fig. 2. Trend in capture fisheries production (tonnes) in Nigeria (1980-2019)
Source: Authors' computation, 2021.

Trend in total fisheries production (tonnes) in Nigeria (1980-2019)

The total fisheries production trend in Nigeria over the study period (1980 – 2019) is shown in Table 3 and Figure 3. The table reveals an increasing trend in the average total fisheries production in Nigeria, with the lowest value of 268,514.20 tonnes recorded in the 1980 - 1989 sub-period, and the highest value of 986,284.20 tonnes in the 2010 -2019 sub-period. The overall average total fisheries production during the period of the study is 547,043.50 tonnes. The average growth rate per annum of total fisheries production fluctuated over the study period varying from 14.99% in the 1980 to 1989 sub-period to 6.078 in 2000 to 2009 sub-period with an overall mean of 298.59%, showing that the total fisheries supply increase enormously over the study period The coefficients of variation reflected a high instability in the total fisheries production in Nigeria over the study period varying from 43.07% in 1990-1999 sub-period to 184.75% in the 1980 to 1989 sub-period, with overall of 53.86% during the study period.

Table 3. Trend in total fisheries production (tonnes) in Nigeria (1980-2019)

Sub-periods	Mean	Annual percent growth rate	Coefficients of variation
1980-89	268,514.20	14.99	184.75
1990-99	353,583.10	50.91	43.07
2000-09	579,792.40	60.78	55.16
2010-19	986,284.20	27.40	111.14
All Period	547,043.50	298.59	53.36

Source: Computed from FAOSTAT, NBS and CBN Statistical Bulletin, 2021.

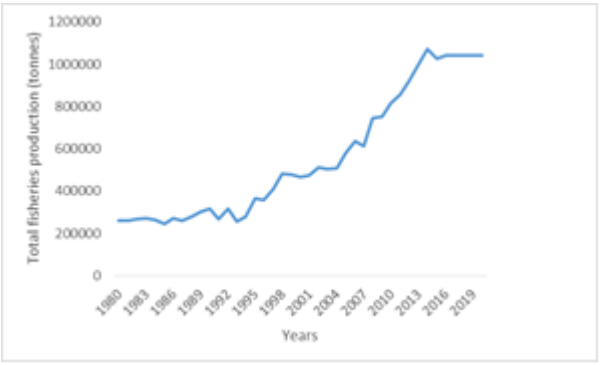

Fig. 3. Trend in total fisheries production (tonnes) in Nigeria (1980-2019)
Source: Authors' computation, 2021.

Results of time series analysis

Unit root test

In time series analysis, it is necessary to consider whether the series contains a unit root or not. In other words, it must be asserted if a time series data is stationary or not. This is because using a non-stationary time series

for regression analysis will give false or spurious results which cannot be used for statistical inference.

It is therefore imperative that time-series data must be stationary before it can be used in regression analysis for the results to be suitable for statistical inference and policy formulation. Results of unit root test of the variables of the model using the Augmented Dickey-Fuller (ADF) test in Table 4 reveals the presence of unit root (non-stationary) in the original values of the model, since the ADF statistics are lesser in value than the critical values at 1%, 5% and10% respectively; hence the null hypothesis of no unit root is rejected. Therefore, the series cannot be used for regression analysis in their original values, because the results will be spurious. The model first difference variables ADF unit root test results are presented in Table 5. Data in reveals that the value of ADF statistics is higher than all the critical values at 1%, 5%, and 10% significant levels, implying the acceptance of the null hypothesis of no presence of unit root in the series.

Table 4. Results of ADF unit root test for variables (original values)

Variables	ADF value	Mackinnon critical values			Decision
		1%	5%	10%	
lnY	-3.02	-3.67	-2.97	-2.62	Non-stationary
lnX_1	-1.84	-3.67	-2.97	-2.62	Non-stationary
lnX_2	-2.30	-3.75	-3.00	-2.63	Non-stationary
lnX_3	-2.11	-3.75	-3.00	-2.63	Non-stationary
lnX_4	-3.13	-3.75	-3.00	-2.63	Non-stationary
lnX_5	-3.47	-3.75	-3.00	-2.63	Non-stationary

Source: Authors' computation, 2021.

Table 5. Result of ADF unit root test for variables (first difference values)

Variables	ADF value	Mackinnon critical values			Decision
		1%	5%	10%	
dlnY	-7.63	-3.68	-2.97	-2.62	I(1)
$dlnX_1$	-5.03	-3.68	-2.97	-2.62	I(1)
$dlnX_2$	-4.45	-3.68	-2.97	-2.62	I(1)
$dlnX_3$	-5.02	-3.68	-2.97	-2.62	I(1)
$dlnX_4$	-6.10	-3.68	-2.97	-2.62	I(1)
$dlnX_5$	-4.62	-3.68	-2.97	-2.62	I(1)

Source: Authors' computation, 2021.

Co-integration test

Johansen's co-integration test result for all variables in the model is shown in Table 6. The results of the analysis reveal 4 co-integrating equations for the variables of the model, showing that a long-run relationship exists among variables of the model, satisfying the condition for analysis with Vector Error Correction Model (VECM).

Table 6. Results of Johansen tests for co-integration

Maximum rank	Parms	LL	Eigen value	Trace statistics	5% critical value
0	114	-1,008.17	-	177.90	94.15
1	125	-972.31	0.87	106.18	68.52
2	134	-946.87	0.77	55.31	47.21
3	141	-931.11	0.57	25.39*	29.68
4	146	-921.77	0.44	5.12	15.41
5	149	-919.58	0.12	0.74	3.76
6.	150	-919.22	0.02		

Source: Authors' computation, 2021

Results of vector error correction model (VECM)

Results of short-run vector error correction model (VECM) regression analysis

Table 7 shows the results of short and long-run VECM regression analysis. From the table, the value of R^2 is 0.550 and is statistically significant at 1%, confirming that the model has a good fit. In the short run, the coefficient of the population (X^2) is negative and statistically significant at a 1% level, showing an inverse relationship between the variable and fisheries supply in the study area.

Table 7. Short run vector error correction model regression analysis results

Variables	Coefficients	Standard error	z-value	p-value
Ce_1	-0.472	0.139	-3.40	0.000*
Total fisheries supply (Y)	0.306	0.344	0.89	0.373
GDP valued in United State dollars (X_1)	0.319	0.264	1.21	0.228
Population in million people (X_2)	-91.515	33.602	-2.72	0.006**
Exchange rate (X_3)	731.073	826.386	0.890	0.376
Interest rate (X_4)	2,767.552	1,952.532	1.42	0.156
Inflation rate (X_5)	41.271	349.730	0.20	0.906
Constant	-1,780.984	27,061.740	-0.07	0.948
R^2	0.556			
Chi-square	35.501*			
p-value	0.000			
AIC	77.425			

* mean significant at 1% level
** mean significant at 5% level
Source: Authors' computation, 2021.

Results of long-run vector error correction model (VECM) regression analysis

VECM long-run results are shown in Table 5. The sign of the coefficient of the population (X_2) is positive and is significant statistically in the long run at a 1% level, implying a direct relationship between this variable and fisheries supply. However, the coefficients of the exchange rate(X_3), interest rate (X_4), and inflation rate (X_5) are negative and statistically significant at a 1% level. This reveals an inverse relationship between these variables and fisheries sup ly in the study area.

Table 8. Long run vector error correction model regression analysis results

Variables	Coefficients	Standard error	z-value	p-value
Total fisheries supply (Y)	1	-	-	-
GDP valued in United State dollars (X_1)	-0.032	0.096	-0.340	0.736
Population in million people (X_2)	17.631	2.800	6.300	0.000*
Exchange rate (X_3)	-2,007.249	402.252	-4.99	0.000*
Interest rate (X_4)	-10,605.920	2,181.254	-4.86	0.000*
Inflation rate (X_5)	1,335.253	415.939	3.21	0.001*
Constant	618,541.60	-	-	-

*mean significant at 1% level
Source: Authors' Computation 2021.

CONCLUSIONS

Based on findings from the study, it is concluded that population, exchange rate, interest rate and inflation rate are significant factors influencing fisheries supply in Nigeria over the study period. In the light of the study findings, there should be improved aquaculture production to reduce the wide supply-demand gap of fisheries supply as a result of population surge. Also, measures should be taken to reduce fish importation significantly to conserve foreign exchange

earnings and cushion the economy against the effects of high inflation and interest rates.

REFERENCES

[1]Adewuyi, S. A., Phillip, B. B., Ayinde, I. A., Akerele, D., 2010, Analysis of Profitability of Fish Farming in Ogun State, Nigeria, Journal of Human Ecology, 31(3): 179 -184.
[2]Akombi, B. J., Agho, K. E., Merom, D., Renzaho, A. M., Hall, J. J., 2017, Child malnutrition in sub-Saharan Africa: A meta-analysis of demographic and health surveys (2006–2016), PLoS One, 12(5): 177-338.
[3]Bradley, B., Byrd, K.A., Atkins, M., Isa, S.I., Akintola, S.L., Fakoya, K.A., Ene-Obong, H., Thilsted, S.H., 2020, Fish in food systems in Nigeria: A review, Penang, Malaysia, WorldFish. Program Report, 2020-06.
[4]Central Intelligence Agency, 2018, Africa: Nigeria, www.cia.gov/library/publications/the-worldfactbook/geos/ni, Accessed on 20th August, 2020.
[5]Chan, C. Y., Tran, N., Pethiyagoda, S., Crissman, C. C., Sulser, T. B., Phillips, M. J., 2019, Prospects and challenges of fish for food security in Africa, Global food security, 20: 17–25.
[6]Desiere, S., Hung, Y., Verbeke, W., D'Haese, M., 2018, Assessing current and future meat and fish consumption in Sub-Sahara Africa: Learnings from FAO Food Balance Sheets and LSMS household survey data, Global Food Security, 16: 116–126.
[7]Food and Agricultural Organization, 2010, Report of the fifth session of the sub-committee on aquaculture Report 950, F.A.O. Rome.
[8]Food and Agriculture Organisation, 2018, The state of world fisheries and aquaculture: Meeting the Sustainable Development Goals, F.A.O. Rome.
[9]Food and Agriculture Organization of the United Nations Statistics Division, 2017, Country indicators: Nigeria, www.fao.org/faostat/en/#country/159, Accessed on 11th September, 2020.
[10]Headey, D., Hirvonen, K., Hoddinott, J., 2018, Animal sourced foods and child stunting, American Journal of Agricultural Economics, 100(5): 1302-1319.
[11]Hicks, C.C., Cohen, P.J., Graham, N.A.J., Nash, K.L., Allison, E.H., D'Lima, C., MacNeil, M.A., 2019, Harnessing global fisheries to tackle micronutrient deficiencies, Nature, 574(7776):95–98.
[12]Kuku-Shittu, O., Onabanjo, O., Fadare, O., Oyeyemi, M., 2016, Child malnutrition in Nigeria: evidence from Kwara State, International Food Policy Research Institute Working Paper, 33.
[13]Lenis, S.O., Liverpool-Tasie , A. S., Thomas, R., Ben, B., 2021, Demand for Imported versus Domestic Fish in Nigeria, Journal of Agricultural Economics, 72: 3, 2021, 782–804.
[14]Nigeria Fishery Statistics, 2016, Summary Report.
[15]Nwokedi, T.C., Odumodu, C.U., Anyanwu, J.O., Ndikom, O.C., 2020, Gap analysis evaluation of Nigeria's fish demand and production Empirical evidences for investment in and policy development for offshore mariculture practices, International Journal of Fisheries and Aquatic Studies, 8(3): 384-394.
[16]Ogundari, K., Categorizing households into different food security states in Nigeria: the socioeconomic and demographic determinants, Agricultural and Food Economics, 5(1):8.
[17]Oyinbo, O., Rekwot, G.Z., 2013, Fishery production and economic growth in Nigeria: Pathway for sustainable economic development, Journal of Sustainable Development in Africa, 2(15): 99-109.
[18]World Bank, 2016, World Bank Data: Nigeria, http://data.worldbank.org/country/nigeria, Accessed on 20th August, 2020.
[19]WorldFish, 2017, WorldFish in Nigeria: Factsheet, Penang, Malaysia.