Research Article

Short-term prediction of fish production in Nigeria: Empirical study Nigeria fish demand and supply

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Abstract

This paper investigates the trend of fish production in Nigeria; contribution of each subsector (Artisanal Fishery, Aquaculture Fishery and industrial Fishery) to its Total Domestic annual Fish Production; the trend and balance in annual fish demand and supply in Nigeria using the growth accounting framework and time series data from 1995 to 2015 to project the viability of Nigeria fishery sector to 2025. The study revealed that the artisanal fishery maintained the highest contributor to the domestics fish production in Nigeria for the study period. It contributed about 77.95% of the total domestic fish production annually. Aquaculture subsector gained the highest growth rate among the three subsectors. It annual growth rate stood at 12.53% while the industrial subsector was seen to be declining in its contribution to the domestic fish production in Nigeria. Result from the study revealed that Nigeria fish self sufficiency ratio dropped from 58% in 1996 to 42% in 2005 and rose steadily to 73% in 2025. It also showed that the Import decency ratio, of fish in Nigeria grew from 41% in 1996 to 60% in 2005 and dropped steadily to 29% in 2025. Perditions used for this study was base on **Holt's Linear Trend Method (Double Exponential Smoothing).** With alpha =0.2 and b=0.7. Descriptive analysis revealed mean, minimum value, maximum value, standard deviation and coefficient of variation parameters used.

Introduction

Fish and fisheries play an important role in the diets, livelihoods, and income of many developing countries. It is well accepted that fish are a good source of animal protein and a major source of source of vitamins and minerals to much poor countries. It is a renewable form of resource found in wide coverage (most water bodies in the world) which makes it readily accessible and cheap source of food throughout the world.

In Nigeria, fisheries contributed 0.88 % to the Agriculture GDP and contribution of Agriculture to Nigeria GDP is 22% (FDF 2018). FDF 2018 also stated that the subsector provides employment for 8.632m million people in the primary sector and 19.55 million people in the secondary sector.

Otubusin, *2011*., Stated that Fish production in Nigeria comes from three sources; artisanal (inland rivers, lakes, costal and brackish water), aquaculture (fish farm) and industrial fishing. Over the years it has been reported that a larger proportion of Nigeria's total domestic fish production is generated by artisanal fisheries. In 2015 the total domestic production was 1.027,058.00 million metric tones. Artisanal fishery contributed 67.7% (694,867.00 mt); aquaculture fishery contributed 30.8% (316,727.00 mt) and industrial fishery contributed 1.5 % (15,464.00) (FDF 2018). Major fish species produced in Nigeria include Torpedo-shaped catfishes (*Clarias spp*.). Tilapias (*hemichromis/ oreochromis.spp*), Smoked fishes, Torpedo-shaped catfishes (*heterobranchus.spp*), African carps (*cyprinidae*), Marine fishes (*osteichthyes*) Elephantsnout (*mormyridae, gnathonems spp*.)Nile/Niger perch (*lates niloticus*) ,Bonga shad (*ethmalosa fimbriata*), Torpedo-shaped catfishes (*clarias lazera*) and Bonytongue fishes (*heterotis spp*.)

Nigeria current population is 193.976 million (FAOSTAT. 2018). With an estimated annual per caput fish consumption of 17.5 kg by FAO, Nigeria projected fish demand for 2018 is 3.61 million metric tones (FDF 2018). Nigeria is the largest consumer of fish products in Africa. Over the years Nigeria has relied importation of fish to meet her ever increasing demand. FAO reported that Nigeria is a net importer of fishery products giving its total fish imports amounting to about USD 1.2 billion and exports valued at USD 284 390 million in 2013.

Several efforts have been made to implement policies and programs to bridge the gap between demand and supply of fish in Nigeria. An aquaculture fishery in Nigeria has gained positive growth as a result of proper implementation of some of these programs. It has grown from 21 700 tones recoded in 1999 to 316,727.00 tones in 2015. This has put Nigeria as the largest aquaculture producer in Sub-Saharan Africa and this importance is steadily increasing at average growth of 20,000mt of cultured fish in Nigeria per year. Considering the significant growth in Nigeria aquaculture sector, to effective bridge to the gap between fish demand and supply in Nigeria there is need to give all fisheries subsectors the needed attention

This study aimed to study the trend in fish supply and demand in Nigeria on possible effects of continuous importation of fish to the Nigeria economy in which the country has comparative advantages.

Materials and Methods

Study area

Nigeria is located between latitude 40-140N and longitude 30-150E. in West Africa It is bordered by the Gulf of Guinea to the south, Benin to the West, Niger to the North and Cameroon and Chad to the East. Area 923,768km2 2 Continental Shelf Area 37,934 km2 3 Length of Coastline 853 km 4 Exclusive Economic Zone 210,900 km.

Figure 1: Map of Nigeria

Source: Google map

Data use for this study are secondary data sourced from FAOSTAT, Federal Department of Fisheries (FDF 2018), Central Bank of Nigeria (CBN) statistical bulletins, Food and Agriculture Organization (FAO) and National Bureau of Statistics (NBS) to determine Nigeria Artisanal Fishery Production (AFP), Nigeria Aquaculture Fish Production (AQUFP), Nigeria Industrial Fish Production (IFP) Total Domestic Fish Production (TDFP), Fish Import, (FI), Fish Export (FE),Total Fish Supply (TFS) and Total Fish Demand (TFD) from 1995 to 2015. Other parameters sourced for the study were Projected Population (PP), Projected Fish Demand (PROJFD) from 2006 to 2025, current GDP of Nigeria, GDP contribution of Agric to Nigeria GDP and contribution of fisheries GDP to agricultural GDP in Nigeria. These parameters were used to analyze the trend of fish production in Nigeria from 1995 to 2015. Data on Total Fish Supply (TFS) from 1995 to 2015 were used to determine statistics of Predicted Fish Supply (PREDFS) from 1995 to 2025. Predicted Fish Deficit (PREDFD) was calculated for 2006 to 2025. Fish Self Sufficiency Ratio (FSSR) and Fish Import Dependency Ratio (FIDR) for the study period were also determined for the period. Descriptive statistics: mean, maximum, standard deviation and coefficient of variation was use to analysis results from the study. Tables and grraphs were to represent results from the study.

The following model were used to derive parameters used for the study

1. Prediction of fish supply (PREDFS)

Holt's Linear Trend Method (Double Exponential Smoothing)

This is accomplished by adding a second single exponential smoothing model to capture the trend (either upwards or downwards). The model takes the following form for all $i > 1$

$$u_1 = y_1 \qquad v_1 = 0$$
$$u_i = \alpha y_i + (1 - \alpha)(u_{i-1} + v_{i-1})$$
$$v_i = \beta(u_i - u_{i-1}) + (1 - \beta)v_{i-1}$$
$$\hat{y}_{i+1} = u_i + v_i$$

where $0 < \quad 1$ and $0 \quad 1$. (*For the study, =0.2; =0.7*)

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2. Fish Self-sufficiency ratio (FSSR)

FSSR = Total Domestic Fish Production (TDFP) x 100/(Total Domestic Fish Production (TDFP) + Fish Import (FI)- Fish Export (FE).

3. Fish Import Dependent Ratio (FIDR)

IDR = Fish Imports (FI)x 100/(Total Domestic Fish Production (TDFP) + Fish Import (FI)– Fish Exports) (FE)

4. Total Fish Supply (TFS)

FS= Total Domestic Fish Production (TDFP) + Fish Import (FI)

5. Predicted Fish Deficit (PREDFDEF)

PREDFDEF= Predicted Fish Supply (PREDFS) - Project Fish Demand (PROJFD)

Results and Discussion

Table 1: Data of Fish Production by Sector from 1995 to 2015

	Artisanal Fish Production (ATFP)	Aquaculture Fish Production (AQUFP)(mt)	Industrial Fish Production (IFP)(mt)	Total Domestic Fish Production (TDFP)	Fish Import (FI) (mt)	Total Fish Supply (TFS)(mt)	Fish Export (Prawn/ Shrimp)(mt)
1995	320,955.00	16,619.00	33479	371053	266448	637501	4,265.28
1996	309,200.00	19,490.00	27244	355934	403273	759207	3,845.50
1997	360,219.00	25,264.60	27703	413186.6	382442	795628.6	2,946.15
1998	433,070.00	20,458.00	29954.58	483482.58	373043.7	856526.28	8,028.16
1999	426,786.00	21,737.60	31139.4	479663	466840	946503	7,418.74
2000	418,069.00	25,720.10	23308.3	467097.4	557884	1024981.4	6,303.25
2001	433,537.00	24,398.00	28378	486313	648196.6	1134509.6	6,694.21
2002	450,965.00	30,664.00	30091	511720	681151.8	1192871.8	7,372.54
2003	446,203.00	30,677.00	33882	510762	663179.52	1173941.52	6,900.00
2004	434,830.00	43,950.00	30421	509201	648033	1157234	7,316.16
2005	490,594.00	56,355.00	32595	579544	611520.45	1191064.45	7,179.27
2006	518,537.00	84,533.00	33778	636848	646484.98	1283332.98	7,736.22
2007	504,227.00	85,087.00	26193	615507	739666.12	1355173.12	5,136.67
2008	511,382.00	143,207.00	29986	684575	937427.68	1622002.68	5,355.00
2009	598,211.00	152,796.00	29698	780705	746851.33	1527556.33	4,761.00
2010	616,981.00	200,535.00	31510	849026	768745	1617771	4,049.00
2011	638,486.00	221,128.00	33485	893099	762508.4	1655607.4	4,377.00
2012	668,754.00	253,898.00	45631	968283	758619	1726902	3,967.00
2013	744,930.00	278,706.00	59871	1083507	770802.59	1854309.59	4,619.00
2014	759,828.00	313,231.00	49952	1123011	776552	1899563	4,577.00
2015	694,867.00	316,727.00	15464	1027058	806000	1833058	4,256.00

Source FDF(2018)

Table 2: Summary statistic of AFP, AQFP, TDFP TFI and TFEX in metric tones from 1995 to 2015

	Mean	Stand. Error	Stand. Deviation	Minimum	Maximum	Coefficient Of Variation (C/V)
(AFP) (mt)	513363.4	28941.90012	132628.448	309200	759828	0.258351984
(AQUFP) (mt)	112627.7	23501.23607	107696.1932	16619	316727	0.956214248
(IFP) (mt)	32560.16	2039.664977	9346.919148	15464	59871	0.287066164
(TDFP) (MT)	658551.2	52838.76494	242137.64	355934	1123011	0.36768232

Table 2 shows the descriptive statistics for fishery performance indicators analyzed. It revealed form the study that for the period under study, Artisanal Fishery contributed 77.95% to the Total Domestic Fish Production, Aquaculture Fishery contributed 17.10% while Industrial Fishery Contributed 4.94% . Estimated values from the study also revealed that the subsectors of domestic fish production in Nigeria (Artisanal Fishery, Aquaculture Fishery and Industrial Fishery) had average annual growth rate of 3.55%, 12.53% and -10.40% respectively while Total Domestic Fish Production was seen to rise 4.74% annually. Also fish importation and exportation was seen to rise by 4.56% and -2.93% respectively. The minimum value of the Total Domestic production recorded was 355934mt which recorded in 1996 while the maximum value was 1123011mt recorded in 2014. The coefficient of variation for, TDPFD, AFP and AQFP, IFP, FI and FE stood at 658,551.22 (mt), 513,363.38 (mt), 112,627.68 (mt),32,560.16 (mt), 638,841.39 (mt) and 5,576.34 (mt) respectively.
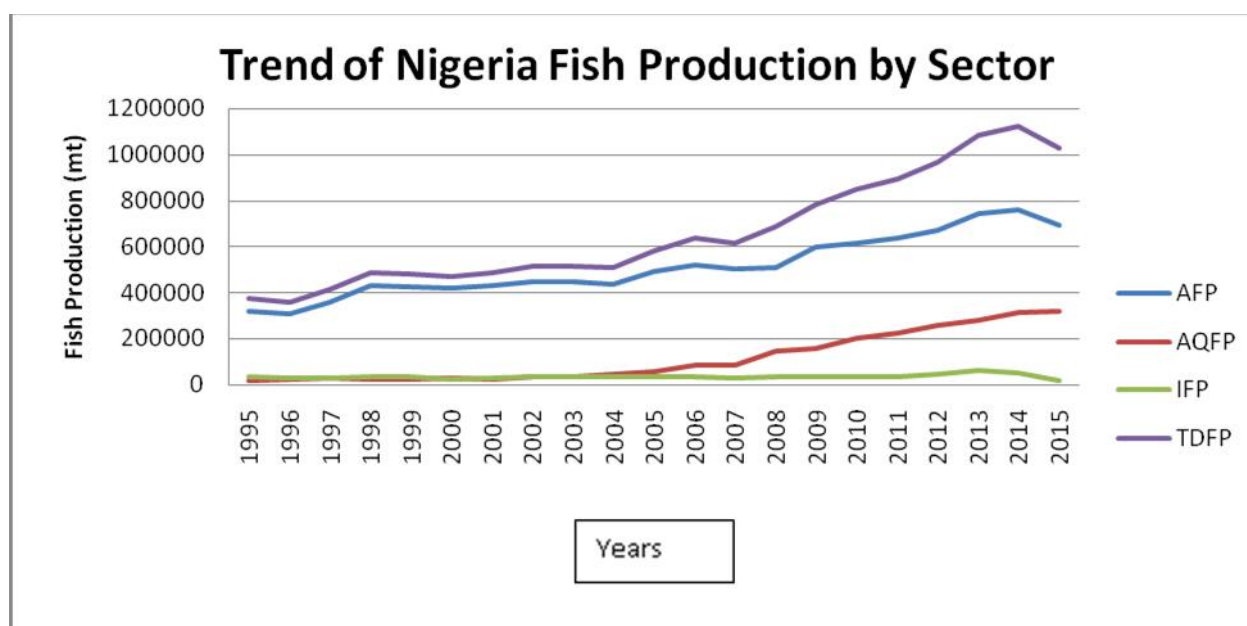

Fig 2; Trend of sources of Nigeria Fish Production from 1995 to 2015
Data Source (FDF 2018)

Table 3: Projected Population (PP), Projected Fish Demand (PROGFD), Predicted Total Fish Supply (PEDTFS) and Predicted Fish Deficit (PREDFDEF) in Nigeria from 2006 to 2025

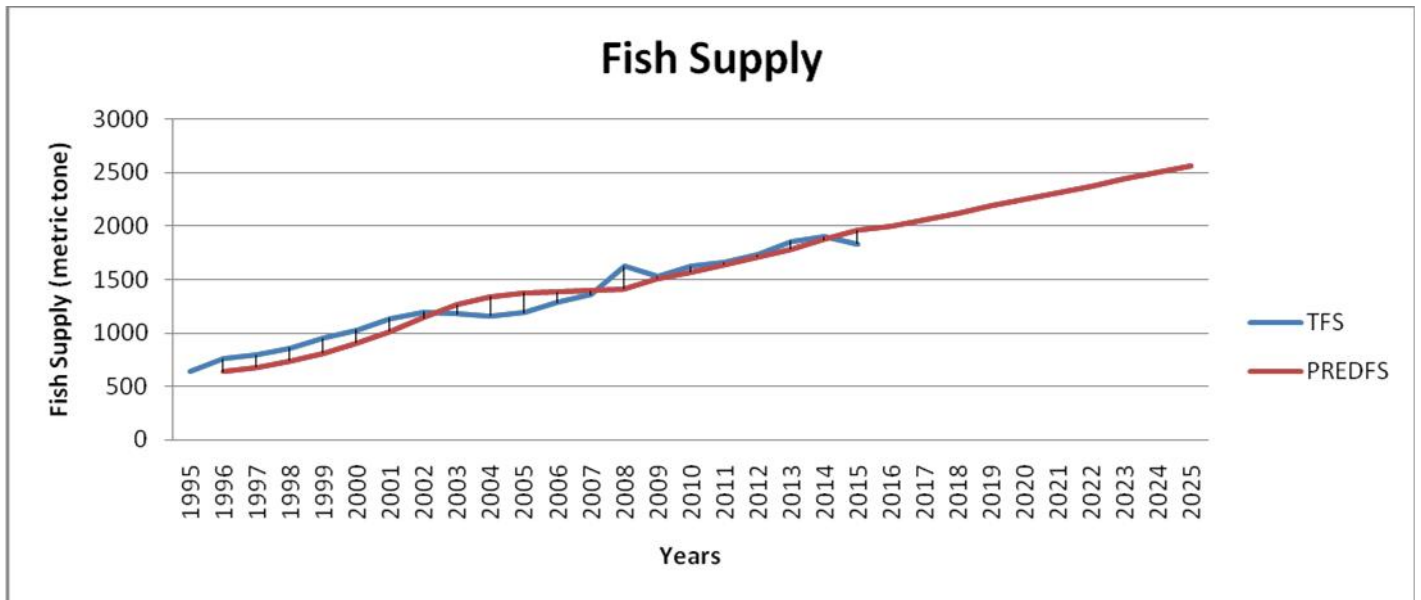| YEAR	Projected Population (PP)	Projected Fish Demand (PROGFD) (mt)	Predicted Fish Supply (PREDFS) (mt)	Predicted Fish Deficit PREDFDEF (mt)	% Deficit
2006	140000000	2,660,000	1,384,607.36	1,275,392.64	47.94709
2007	144500000	2,750,000	1,395,635.54	1,354,364.46	49.24962
2008	149100000	2,830,000	1,413,161.38	1,416,838.62	50.06497
2009	153900000	2,920,000	1,509,785.74	1,410,214.26	48.29501
2010	158800000	3,020,000	1,570,683.84	1,449,316.16	47.9906
2011	163900000	3,110,000	1,644,037.46	1,465,962.54	47.13706
2012	169100000	3,211,000	1,711,907.42	1,499,092.58	46.68616
2013	174500000	3,320,000	1,782,561.56	1,537,438.44	46.30839
2014	180100000	3,420,000	1,874,611.11	1,545,388.89	45.18681
2015	187,301,926	3,280,000	1,960,794.69	1,319,205.31	40.21967
2016	193,392,517	3,380,000	1,998,557.43	1,381,442.57	40.87108
2017	199,681,159	3,490,000	2,061,867.50	1,428,132.50	40.9207
2018	206,174,292	3,610,000	2,125,177.57	1,484,822.43	41.13082
2019	212,878,566	3,730,000	2,188,487.64	1,541,512.36	41.32741
2020	219,800,846	3,850,000	2,251,797.71	1,598,202.29	41.51175
2021	226,948,221	3,970,000	2,315,107.78	1,654,892.22	41.68494
2022	234,328,011	4,100,000	2,378,417.85	1,721,582.15	41.98981
2023	241,947,773	4,230,000	2,441,727.92	1,788,272.08	42.27594
2024	249,815,311	4,370,000	2,505,037.99	1,864,962.01	42.67648
2025	257,938,682	4,510,000	2,568,348.07	1,941,651.93	43.05215

Sources FDF (2018) and author estimates

Fig 3: Trend in Total Fish Supply (from 1995 to 2015 and Predicted Trend of Fish Supply from 2006 to 2025
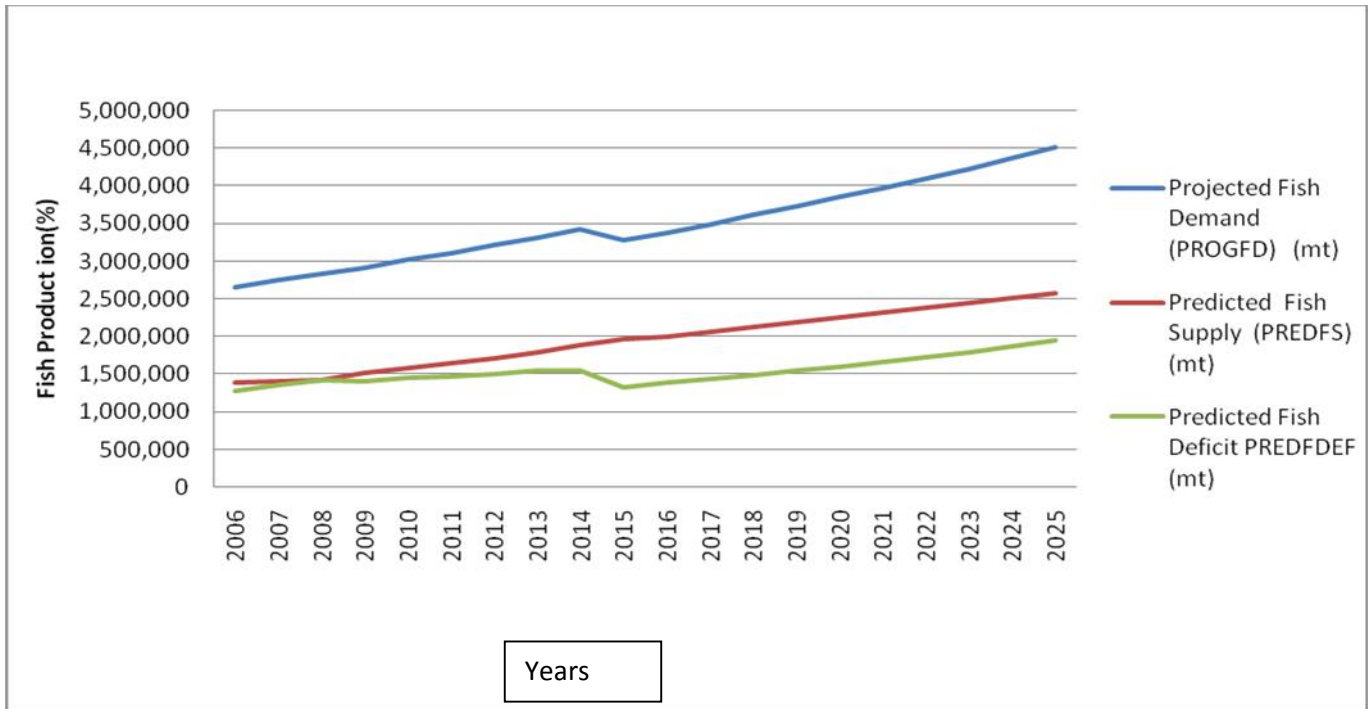Data source Data Source (FDF 2018)

Fig 4; Projected Trend of Fish Demand (PROJFD), Predicted Fish Supply (PREDFS) and Predicted Fish Deficit (PREDFDEF) of Nigeria from 2006 to 2025
Data Source (FDF 2018)

Table 3: Summary statistic of Projected Population (PP) Projected Fish Demand (PROGFD), Predicted Total Fish Supply (PREDTFS), Predicted Fish Deficit (PREDFDEF) and Percentage Deficit of Fish Products in Nigeria from 2006 to 2025

	Mean	Standard Error	Standard Deviation	Minimum	Maximum	c/v
NNP	1.93E+08	8236375.333	36834190.26	1.4E+08	257938682	0.2000853
PROGFD (MT)	3488050	122437.5775	547557.4928	2660000	4510000	0.1606098
PREDTFS (MT)	1954116	87045.55387	389279.5512	1384607	2568348.07	0.1997995
PREDFDEF (MT)	1533934	40351.88321	180459.1078	1275393	1941651.93	0.1165622

Fig 4: showed that the demand of fish increased steadily with 3% from, 2006 (2,660,000 mt) to 2014 (3,420,000 mt) and experienced a decline with about (140,000 mt) 4.09% in 2015 . The projected fish demand assumed another increasing trend from 2016 (3,280,000 mt) with about 3% and maintained this percentage increase to 2025(4,510,000 mt). The mean projected fish demand is 3488050 while the minimum and maximum values stood at 2660000 mt and 4510000 mt respectively. It coefficient of variation was 0.160 (Table3). Similarly Fig 2 revealed the trend in the Predicted Total Fish Supply increase slightly evenly from 2006 (1,384,607.36 mt) to 2025 (2,568,348.07 mt) with average rate of 3.19%. The mean of Predicted Total Fish Supply for the period studied was 1954116 mt the minimum and maximum values were 1384607 mt and 2568348.07 respectively while the coefficient of variation was 0.199.

Predicted Fish Deficit for the study period showed similar trend as projected Fish Demand in Nigeria. However, the demand and supply gap increased annually with 1.98% from 1,275,392.64 mt (47.9% deficit) in 2006 to 1,941,651.93 mt (43.05% deficit)in 2025.The average Fish deficit for the study period was recorded at 1533934 mt and the coefficient of variation was 0.12
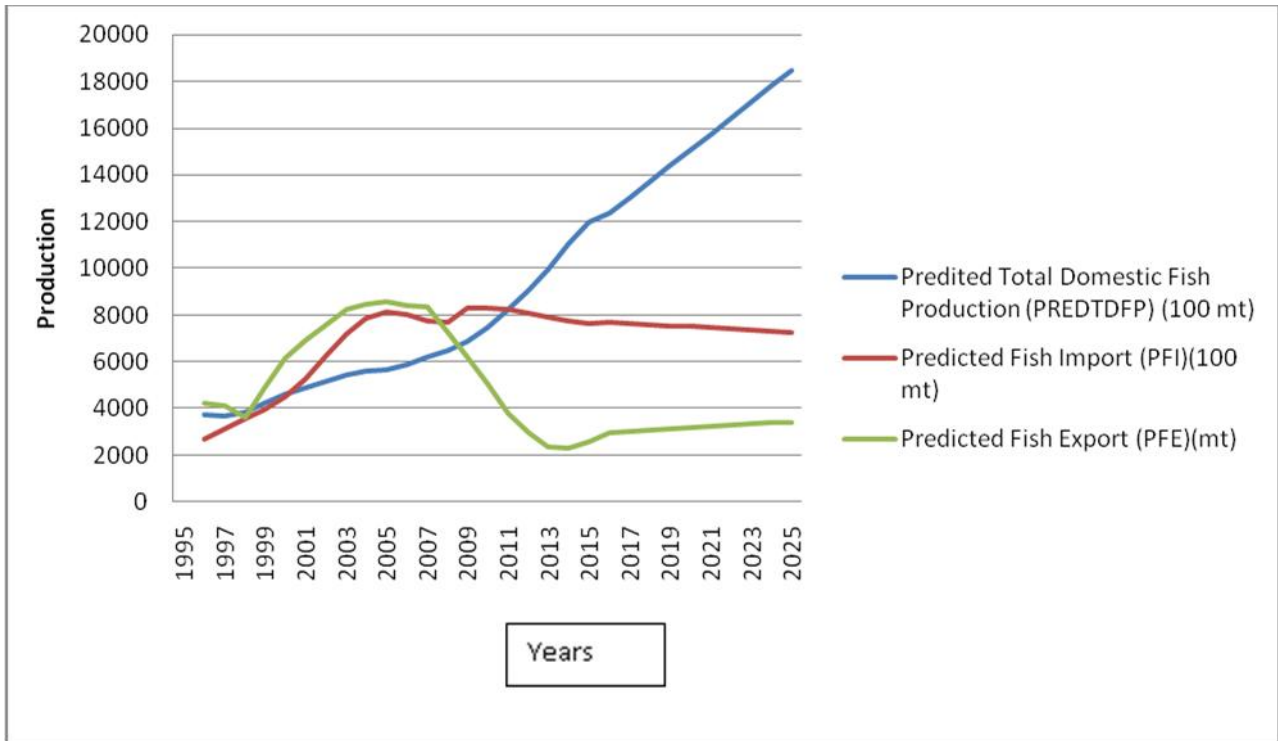
Fig 5; Pradicted Trend of Total Fish Demand (PREDTDFP), Predicted Fish Import (PFI) and Predicted Fish Deficit (PFE) of Nigeria from 1995 to 2025
Data Source (FDF 2018)

From Fig 5, the three parameter indicators increased evenly from 1995 to 2005, while Total Domestic Fish production continued to increase steadily from 2005 to 2025. Fish import remained at a steady level of supply from 2005 to 2025 however there was slight decline which progressed steadily from 2013 to 2025. Fish export experienced a sharp decline from 2007 to 2014 then appreciated slightly with a steady increase from 2017 to 2025.
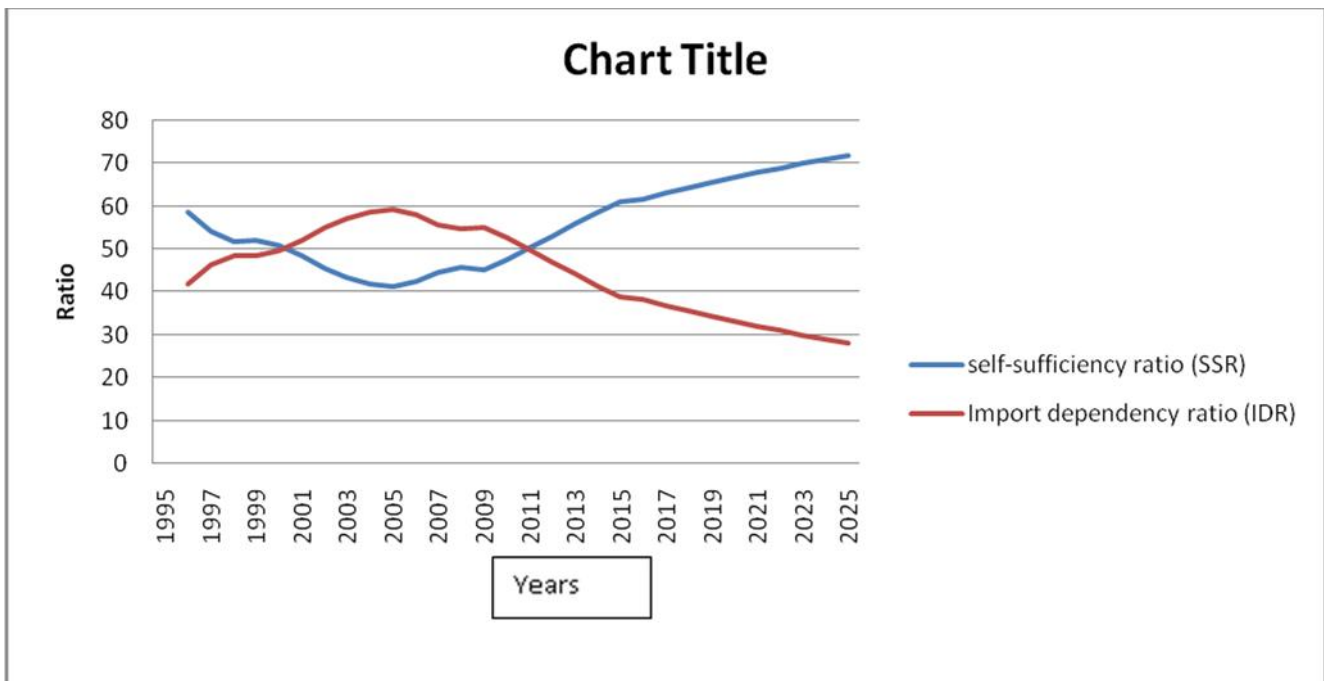

Fig 6: Predicted trend of self -sufficiency and Import Dependency Ratio of Fish products in Nigeria from 1995-2025

From Fig 5, Nigeria self sufficiency in fish products dropped from 58% in 1996 to 42% in 2005 and rose steadily to 73% in 2025. Contrast to the trend observed for self sufficiency ratio, Nigeria fish import decency ratio, grew from 41% in 1996 to 60% in 2005 and dropped steadily to 29% in 2025.

Conclusion and Recommendations

Fish production in Nigeria is significantly important to the nation's economy. The adverse variance between production and consumption implies high growth potential in fish production.
The demand for fish in Nigeria is yet to be met through domestic fish production. In order to intensify the fishery production in Nigeria, priority attention should be given to all subsectors contributing to the Nigeria Fish Domestic production.

For capture fisheries there should more exploratory studies to adequately map out potential fishing ground in Nigeria waters. Nigeria, has got to build up a strong fleet of distant water fishing trawlers with up-to-date technologies for the exploitation of our off shore fishery resources, rather than concentrating all our effort within the inshore region. These activities will increase the yield, and help to solve the fish/food problem to a very great extent. Government should provide social infrastructures in rural fishing communities to encourage the teaming youth from these communities to adopt fishing as means of livelihood.

For aquaculture, there should be improvement in technology and resources use, development of additional area for aquaculture. Aquaculture promoting programs like Anchor from government should be encouraged. Farmers should be organized into cooperative groups in other to easily access loans and credit facilities. More coordinated fish farm settlements should be built by government or cooperate organizations. This will help to centralize fish farmers for easy access for interventions purposes. Storage and processing industries should be develop to add to the value-chain in fish farming.

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