Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 20, Issue 3, 2020
PRINT ISSN 2284-7995, E-ISSN 2285-3952

PROFITABILITY OF SMALL-SCALE CATFISH PRODUCTION IN SOUTHWEST NIGERIA: THE CHALLENGES

Olubunmi Olanike ALAWODE[1], Stephen Olubusoye AJAGBE[2]

[1]University of Ibadan, Department of Agricultural Economics, Ibadan, Nigeria, Email: busolaferanmi@gmail.com
[2]Forestry Research Institute of Nigeria, Department of Wildlife and Ecotourism, Jericho, Ibadan, Nigeria, Email: stephenolua@gmail.com

Corresponding author: busolaferanmi@gmail.com

Abstract

Challenges, risks and constraints are intrinsic part of any business; fish farming is not an exception. These limit the potential and expected profit of the business. This study analysed the profitability and the challenges limiting the profitability of catfish production in Southwest Nigeria. A 2-stage random sampling procedure was used to select 400 catfish farmers in four randomly selected states in Southwest Nigeria. Structured questionnaire was designed to collect data. Descriptive statistics, Gross margin analysis, Benefit Cost Ratio (BCR) and Expense Structure Ratio (ESR) were used to analyse data. The results show that on the average, size of catfish at harvest was 1.02Kg, production period was 4.37 months, market price was ₦645.45 and the breakeven price was ₦474.43. Also, the total revenue was ₦1,269,961.60, total cost was ₦933,467.98, profit was ₦336,493.62, BCR was 1.36 and ESR was 0.05. Although catfish farming is profitable in Southwest Nigeria, five categories of challenges limiting the profitability of catfish production were identified; profitability, weather, fish diseases and predators, security, and fish marketing challenges. Lack of technical know-how on the part of fish farmers contribute to the severity of business risks and challenges. These challenges have to be thoroughly analysed and adequate plans have to be made to reduce or eliminate their effects on the expected profit and success of the business. Fish farmers should prepare their business plans, analyze the market and evaluate their strengths and opportunities to minimize or eliminate the weaknesses and threats against the success and profitability in catfish business.

Key words**:** *fish diseases, fish marketing, production cost, security, weather effect*

INTRODUCTION

Challenges, risks and constraints are intrinsic part of any business; fish farming is not an exception. These limit the potential and expected profit of the business. Small-scale aquaculture enterprise has promising potentials in making the dreams of entrepreneurs come true. The major, if not the sole objective of going into any business, is to make profit. Profit is the driving or motivational force of any business that keeps it going. Fish farming is a profitable business (Ajagbe and Ojo-Fakuade, 2019; Alawode and Oluwatayo, 2019; Edet *et al*., 2018; Ashley-Dejo *et al*., 2017) [5, 7, 12, 10]. But Engle (2010) [14] reported that the profit potential of small-scale aquaculture enterprise is often accompanied by a variety of risks and challenges, and the large sums of money invested in an aquaculture business can be lost quickly. Therefore, there is need to critically identify any potential or imaginary risks or challenges that can limit the profitability of catfish production. These challenges have to be thoroughly analyzed and adequate plans have to be made on how to deal with them individually (or collectively if possible). This is the best method to reduce or eliminate their effects on the expected profit and success of the business.

There are a number of overarching trends and challenges that prospective aquaculture business owners should consider (Engle, 2010) [14]. These challenges are the limiting factors to the profitability of fish farming. They can be viewed from three points; challenges due to lack of technical know-how of the manager which can be seen in wrong combination of input resources, inherent challenges of fish farming (genetics of the fish), and external challenges. However, Leadway Assurance (2017) [23] classified risks facing fish production in Nigeria as pure

risks and business risks. Pure risks are those that arise due to unexpected circumstances such as theft, outbreak of diseases, unexpected extreme climatic factors, malicious damage, legal actions against the farm, and etcetera. Business risks can be seen as inherent parts of a business that need to be technically managed for the success and profitability of the business. They arise as a result of weaknesses and threats analysis of business in SWOT analysis.

Solutions to all anticipated risks and threats can be done on paper, in form of a business plan, before the physical running of the business. This will give the investor or intending fish farmer impetus to go ahead with his plan with higher degree of expected success or to hold on. Business plan is the valid tool or avenue to carry out production or biological, financial and marketing analysis of small-scale aquaculture. It will assess the strengths and opportunities available for the proposed aquaculture business as well as the weakness and threats militating against its success. They must all be weighed together.

Strengths have to be evaluated and compared to the weakness. To be sure of success and profit in the farming business, strengths must outweigh the weaknesses, just as opportunities must outweigh the threats. Moreover, there must be strategy(s) to reduce the severity of threats and weaknesses. But many fish farmers overlook the importance of business plan before going into the business. They are moved only by the advice of the motivational speakers or consultants that convince them that aquaculture business is a profitable venture. These fish farmers are bound to make mistakes.

One of the major challenges of fish farming business is high cost of feed. Feed cost always claim higher percentage than all other input materials cost put together (Engle, 2010) [14]. Therefore, feed cost has direct impact on the output and profitability of catfish production. Many studies had reported that feed and cost of feed are the major constraints of fish production. For example, Olayiwola (2013) [29] identified feed and hired labour as factors influencing technical efficiency of fish production in Ijebu-ode Local Government Area of Ogun state. Osawe *et al*. (2008) [32] observed that feeding is highly contributing to increase in technical inefficiency and decrease technical efficiency of fish production. That is, the more the farmers feed the fish per day with low quality feed, the less their output efficiency. This is an identified weakness of fish farming business. The strategy to combat this is to carefully and appropriately feed the fish to ensure a better feed conversion ratio that will increase the weight gain and eventually increase the chances of profitability and success of the business (Engle, 2010) [14].

This study examined the challenges to the profitability of catfish production in Southwest Nigeria. Specifically, this study:

(i)Examined the performance of catfish over the period of production

(ii)Determined the cost of production (breakeven cost)

(iii)Examined the profitability of catfish farming

(iv)Investigated the challenges to the profitability of catfish farming

MATERIALS AND METHODS

The Study Area

This study was carried out in Southwest Nigeria. The Southwest Nigeria is one of the six geopolitical zones in Nigeria and it is dominated by Yorubas. It comprises of six states; Lagos, Ogun, Oyo, Osun, Ondo and Ekiti. These States have good quality freshwater that easily support abundant fish production unlike other geopolitical zones that either have problems of low water table, scarcity of water or polluted water (due to oil spillage). These problems make fish production in some other geopolitical zones difficult. Therefore, Southwest Nigeria becomes the favourable zone for fish production in Nigeria, in which other geopolitical zones come to source fish to meet their increasing demand for fish.

Sampling procedure

Structured questionnaire was designed to collect the required data for this study. The information sought include various input resources employed in catfish production,

performance of catfish over the period of production and challenges encountered by catfish farmers in Southwest Nigeria. A 2-stage random sampling procedure was used to select respondents for the study. The first stage involved the random selection of four states in Southwest Nigeria. The selected States are Lagos, Ogun, Oyo and Osun. The second stage involved the random selection of small-scale catfish farmers from the Catfish Farmers Association of Nigeria (CATFAN) in each state. The sampling frame consists of registered catfish farmers across all the local government areas in each state. In each state, 100 members of CATFAN were randomly selected for the administration of the questionnaire giving a total of 400 respondents.

Analytical Methods

Descriptive statistics were used to examine the performance of catfish over the period of production and investigate the challenges to the profitability of catfish farming. Costs analysis was done to determine the cost of production. On the basis of the performance of catfish over the period of production and the costs and returns analysis, the gross margin was used to determine the gross margin and profitability of catfish enterprise. Benefit Cost Ratio was used to explain the profitability of the small-scale catfish business. Expense Structure Ratio shows the percentage contribution of the fixed cost to the total cost of production.

Performance of catfish over the period of production

Performance of catfish was determined by analysis of minimum and maximum inputs that farmers used to produce minimum and maximum output catfish in a particular production cycle. The mean values of inputs and outputs of catfish were obtained by dividing the overall values of input variables and catfish output by the total number of fish farmers.

Cost of production (breakeven cost)

The average production cost or breakeven price was obtained following Engle (2010) method [14]. It is a measure of the cost of producing a single unit (Kg) of product (catfish). It is obtained by dividing the average total cost of production by the total quantity of catfish output or the total weight of catfish at harvest.

This is given as:

Average production cost (APC)
= ATC (₦)/Total catfish output (Kg)..... (1)

Profitability Analysis

Income statement was prepared using the data collected. From the income statement, costs and returns analysis was done to determine the profitability of small-scale catfish farming business in Southwest Nigeria. Two methods of profitability analysis; cost and return analysis and Benefit-Cost ratio, as described by Alawode and Oluwatayo (2019) [7] were adopted as follows:

Gross Margin (GM):

$TR = P_Q Q$ ……. (2)
$TVC = \sum P_i X_i$ ……..... (3)
$TFC = \sum P_n Y_n$ ……..…….. (4)
$TC = P_j Z_j$ ….…… (5)
$P_j Z_i = \sum P_i X_i + \sum P_n Y_n$ ……(6)
$TC = TVC + TFC$…….. (7)
$GM = TR - TVC$…… (8)
$\Pi = GM - TFC$……... (9)

By combining equations 8 and 9, then, profit (Π) becomes:

$\Pi = TR - TVC - TFC$ …… (10)
$\Pi = TR - (TVC + TFC)$…….…….. (11)

Therefore, profitability can be simply calculated by subtracting total costs of production from total revenue. A positive margin shows a gain or profit for the business while a negative margin shows a loss for the business (Alawode and Oluwatayo, 2019; Engle, 2010) [7, 14].

$\Pi = P_Q Q - P_j Z_j$ …….. ..... (12)

where:
Π = Profit or Net farm income (₦)
P_Q = Price (₦) per Kg of catfish,
Q = Total quantity of output of catfish in Kg,
Pi = Price of each ith variable input used in production
X_i, Y_n and Z_j = Quantities of variable, fixed and total inputs used in production
$TR = P_Q Q$ = Total revenue (₦)

$TVC = \sum P_i X_i$ = Total variable cost (₦)
$TFC = \sum P_n Y_n$ = Total fixed cost (₦)
$TC = P_j Z_j$ = Total cost of production (₦)

Benefit Cost Ratio (BCR)

$$BCR = TR / TC$$
$$= P_Q Q / P_j Z_j \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (13)$$

If Benefit cost ratio (BCR) is less than 1, the business is not profitable and there will be negative return on investment; if BCR is greater than 1, the business is profitable and there will be positive return on investment. This is called viability test of a business (Ajagbe and Ojo-Fakuade, 2019; Alawode and Oluwatayo, 2019) [5, 7].

Expense Structure Ratio (ESR)

$$ESR = TFC / TC = P_n Y_n / P_j Z_j \ldots\ldots\ldots\ldots\ldots (14)$$

Expense Structure Ratio (ESR) shows the percentage contribution of the fixed cost to the total cost of production

RESULTS AND DISCUSSIONS

Performance of catfish over the period of production

Table 1 shows that the size of fish seed stocked was between 4g and 20g with a mean of 8.91±0.55g while the number of fish seed stocked was between 200 and 10,000 catfish with a mean of 2,141.82±237.56. Issa *et al*. (2014) [21] reported that fish seed stocked in small-scale catfish farms in Kaduna state varied between 500 and 6,000 fingerlings. But, Onyekuru *et al*. (2019) [31] reported the number of stocked fish to vary between 50 and more than 1,000 fish seed.

Table 1 shows that quantity of feed given to the fish during production period in the study area varies between 429 Kg and 3,750 Kg with a mean of 1,311 Kg.

The size of fish at harvest varies between 450g and 1,800g with a mean of 1,022.73g±45.94. Onyekuru *et al*. (2019) [31] reported catfish size at harvest to vary between 1,000g and 1,500g.

The price of catfish in the study area varies between ₦500 and ₦910 with a mean of ₦645.45 ± 9.11 per kilogram. But, Issa *et al*. (2014) [21] reported that the price of catfish in Kaduna state varied between ₦300 and ₦450, which is lower than minimum market price of catfish in Southwest Nigeria.

Table 1. Performance of Catfish over the period of production

Variable	Mini	Max	Mean
No of fish stocked	200	10,000	2,141.82 ± 237.56
Cost of fish seed (₦)	25	32	28.5 ± 34
Average size stocked (g)	4	20	8.91 ± 0.55
Average size at harvest (g)	450	1,800	1,022.73 ± 45.95
Production period (Months)	3	6	4.37 ± 0.11
Av. No at harvest	190	9,700	1,923.83 ± 233.69
Feed quantity fed (Kg)	429	4,592	2,510.29 ± 22
Selling price /Kg (₦)	500	910	645.45 ± 9.11

Source: Data Analysis, 2019.

The price regime is fixed with respect to harvest size of the fish. The farmers in the study area produced different sizes of fish ranging between smoked size to Abuja size, with respect to the farmers' ability and customers' preferences. On the average, a catfish farmer stocks 2,142 juvenile catfish per pond and harvest 1,924 table size fish. Also, on the average, a catfish farmer feeds the fish with 2,510Kg of feed and sells at ₦645 per Kg, for a period of 4.37 months. However, Onyekuru *et al*. (2019) [31] reported that the catfish production period in Nsukka Local Government Area of Enugu state, Southeast Nigeria, varied between 6 and 9 months. This is far greater than period of catfish production in the Southwest Nigeria as obtained in this study (Table 1).

Cost of production

Average cost of production of catfish obtained from this study is ₦474.43/Kg. This is the breakeven price. This is the price of producing a kilogram of catfish in the study area. Farmers always watch out for the cost of production and always trying to keep it as low as possible. This is because it is the determinant of profit in catfish production. It must be lower than the minimum market price of catfish. That is, the lower the cost of

production, the higher the profit and vice versa. Therefore, to make profit, farmers have to sell their catfish at a price higher than ₦474.43/Kg. It has been stated (Table 1) that catfish is sold between ₦500 and ₦910 with a mean of ₦645.45±9.11. It is then clear that catfish farmers in the study area make profit. The calculations are as follows:

Average total cost (ATC) = ₦933,467.98
Average number of fish stocked= 2,141.82
Average number of fish harvested = 1,923.83
Average weight (g) of fish at harvest = 1,022.73g
Total weight at harvest (Kg) =
Average number fish harvested x Average weight at harvest = 1,923.83 x 1,022.73g =
1,967,559g /1,000 = 1,967.56 Kg
Average production cost (APC) =
(ATC (₦)/Total weight at harvest (kg))=
₦ 933,467.98/1967.56 kg= ₦474.43/Kg

Profitability of Small-Scale Catfish Production

Table 2 shows that the average total revenue obtained from small-scale catfish production in Southwest Nigeria is ₦1,269,961.60 (1967.56 x 645.45). A total variable cost (TVC) of ₦884,893.50 and total fixed cost (TFC) of ₦48,574.48 were incurred during the course of production. The sum of these costs gives the total cost (TC) of catfish production to be ₦933,467.98. The value of TVC was subtracted from the total revenue to obtain the gross margin of ₦385,068.10. Moreover, average net farm income or profit obtainable in small-scale catfish production in Southwest Nigeria is ₦336,493.62 per production period. This is consistent with the findings of Okpeke and Akarue (2015) [27], who reported ₦384,306 as net farm income of fish farming business in Warri South Local Government Area of Delta State, Nigeria. This implies that small-scale catfish production is a profitable business in Southwest Nigeria. This observation corroborates the findings of Ajagbe and Ojo-Fakuade (2019); Edet *et al*. (2018); Iruo *et al*. (2018); Ashley-Dejo *et al*. (2017) [5, 12, 20, 10]. Profit is the major, if not the sole factor that makes the business feasible or viable and keeps it moving over several cycles of production.

The contribution of total variable cost and total fixed cost to the total cost of production were found to be 94.8% and 5.2% respectively. This results indicate that total variable cost that includes the cost of feed, water, labour, fuel, lime, harvesting, and etcetera, is the major factor in catfish production. This observation is consistent with the result of Onyekuru *et al*. (2019) [31], they estimated the contribution of total variable cost and total fixed cost to the cost of catfish production to be 86.58% and 13.42% respectively, in Nsukka Local Government Area of Enugu state, Nigeria. Ashley-Dejo *et al*. (2017) [10] reported that total variable cost contributed 86.6% while total fixed cost contributed 13.4% of the total cost of production in Oyo State. Also, Oluwasola and Ige (2015) [30] observed that total variable cost contributed 96.66% and total fixed cost contributed 3.34% to the cost of catfish production in Ibadan, Oyo State.

However, cost of feed has the largest percentage contribution to the cost of catfish production in Nigeria. Most quality fish feed are imported and this contributes to high cost of fish feed and eventually, high cost of production. This observation is in agreement with Alawode and Oluwatayo (2019); Ashley-Dejo *et al*. (2017); Okpeke and Akarue (2015) [7, 10, 27]. The implication of this is that fish feed is an important factor of catfish production. In addition, if feed is not properly managed by the farmers and efficiently utilized by catfish, it will have negative effect on profit (Robinson and Li, 2015; Engle, 2010) [33, 14]. However, Edet *et al*. (2018) [12] had a contrary observation. They reported that total variable cost contributed 42.86% while total fixed cost contributed 57.14% to the cost of catfish production farming in Calabar metropolis, Cross River state, Nigeria.

The value of benefit cost ratio (BCR) was estimated to be 1.36. This value implies that for every ₦1 invested in catfish production in Southwest Nigeria, there will be a return of 36 kobo (₦0.36) or a profit of 36% on investment made. This shows that catfish farming is a profitable business in Southwest Nigeria. Ajagbe and Ojo-Fakuade (2019) [5]

reported BCR of 1.74 for catfish production in Ibadan Metropolis, Oyo state, Nigeria. Alawode and Oluwatayo (2019) [7] reported BCR of 3.95 among Fish Farmers participating in Fadama III in Lagos state, Nigeria. Ashley-Dejo *et al*. (2017) [10] reported a BCR of 1.69 among small-scale catfish farmers in Oyo state, Nigeria. Tunde *et al*. (2015) [35] reported BCR of 1.9 among fish farmers in Saki-East Local Government Area of Oyo state, Nigeria.

The expense structure ratio (ESR) of catfish production in Southwest Nigeria is 0.05. This implies that total fixed cost contributes only 5% to the total cost of catfish production in the study area. But Ajagbe and Ojo-Fakuade (2019) [5] reported an ESR of 0.07 for catfish production in Ibadan Metropolis, Oyo State, Nigeria, and Ashley-Dejo *et al*. (2017) [10] reported an ESR of 0.15 for catfish production from all the four agricultural extension zones of Oyo state. Much more, Ume *et al*. (2016) [36] estimated an ESR of 0.48 for catfish production in Anambra State, Nigeria. These values are greater than what was obtained in this study. However, Oluwasola and Ige (2015) [30] reported an ESR of 0.03 for catfish production in Ibadan, which is lower than what was obtained in this study. Nevertheless, it is obvious that the contribution of the total fixed cost to the total cost of production of catfish in Nigeria is far less than the contribution of total variable cost. This makes catfish farming viable because fixed cost will relatively remain constant during the cause of production. Therefore, revenue and most especially, the profit, is largely determined by the variable cost; that is, increase in revenue is directly proportional to the increase in the variable cost (Ajagbe and Ojo-Fakuade, 2019; Ashley-Dejo *et al*., 2017) [5, 10].

The contribution of total fixed cost appeared to be negligible in the total cost of catfish production in Southwest Nigeria. Most small-scale catfish farmers in Southwest Nigeria have devised an alternative means aimed at reducing the effect of total fixed cost in the cost of production. The major assets or capital investment in catfish fish production are land, ponds (pond construction), harvest (drag) net, well or bore hole and water pump machine. These high level fixed costs make catfish production a capital intensive business (Engle, 2010) [14].

Table 2. Income statement and profitability analysis of catfish farming enterprise

	Average value (₦)
Total revenue	**1,269,961.60**
Variable inputs	
Fish seed	61,018.50
Lime	1,756.52
Fertilizer	1,300.00
Water	225,357.14
Water analysis	14,000.00
Feed	545,611.53
Labour	18,266.67
Harvest	5,375.00
Medication	2,347.06
Fuel	5,095.10
Running Cost	4,765.98
TVC	**884,893.50**
Gross Margin	**385,068.10**
Fixed inputs	
Pond	33,090.91
Dragnet	6,729.17
Water pump machine	6,233.57
Equipment	2,520.83
TFC	**48,574.48**
Total cost	**(933,467.98)**
Net farm income	336,493.62
BCR	1.36
ESR	0.05

Source: Data Analysis, 2019
NB: TVC: Total Variable Cost; TFC: Total Fixed Cost

This is evident in the work of Edet *et al*. (2018) [12] who reported higher fixed cost percentage contribution. In addition, all these assets are difficult to convert to cash if the farmer decided to quit the business (Engle and Stone, 2002) [15]. Therefore, most catfish farmers have opted to rent all these assets either per production cycle or yearly to reduce the cost of maintenance and cost of production. This observation is corroborated by the result of Ajagbe and Ojo-Fakuade (2019) [5]. Likewise, most catfish farms are located along natural water source for regular supply of water. This makes the cost of water very negligible or zero in the cost of production.

Challenges to Catfish Production

In Table 3, five major categories of challenges facing catfish production in Southwest

Nigeria were identified; profitability, weather effects, fish diseases and predators, security, and fish marketing challenges. These challenges limit the profitability of catfish farming business. This study and others had established the profitability of catfish farming business. Engle (2010) [14] stressed it further that the profit potential in catfish farming business is often accompanied by a variety of risks, and the large sums of money invested can be lost quickly. Therefore, there is need for adequate and thorough planning, monitoring, and assessment of the economics and finances to prevent such losses.

The profitability challenges include challenges that mostly and directly contribute to the cost of production. It may sometimes depend on the level of management expertise employed in catfish production (Engle, 2010) [14]. The results showed that all catfish farmers (100%) in the study area agreed that high feed cost contribute negatively to the profitability of catfish production. This implies that feed is the single largest component of cost of production and as such, it is the most significant determinant of profit in catfish production (Engle, 2010) [14]. This observation corroborates the findings of Alawode and Jinad (2014) [6] that feed inputs had negative relationship with output. This also corroborates the findings of Mohammed *et al*. (2015) [24] who found that the most pressing challenge militating against small-scale catfish farming is high cost of feed. Further, Iheke and Nwagbara (2014) [19] recorded that all catfish farmers in Abia state, Nigeria, agreed that the major problem facing catfish production is high feed cost. In the same vein, Asa and Obinaju (2014) [9] ranked cost of feed as most severe among other constraints of catfish fish farming.

Therefore, some farmers adopt many methods to cut the cost by giving their fish maggots, chicken intestine and unhatched chicken eggs. Therefore, 9.2% of the farmers perceived that the business is not highly profitable. All other challenges identified by catfish farmers are potential factors limiting catfish profitability. In order to minimize or eliminate the effects of this challenge, catfish farmers must be thoroughly trained to feed their fish with quality feed and to feed efficiently to keep feed conversion rate (FCR) below 2 (Robinson and Li, 2015) [33].

The second category of challenges is the climate change which is largely determined by flood and temperature variation. The impact of climate change is increasing in fish production in Nigeria. Challenges due to climate change on catfish farming include temperature variability, flooding and lack of abundant water for fish production. These are external challenges that can naturally affect or limit catfish production. The growth and survival of fish are highly correlated with water quality. Fish are cold-blooded animals; the temperature of their environment directly influences all their body metabolic activities. Fish appetite is always reducing when pond water temperature is too low. This observation corroborates the report of Robinson *et al*. (1998) [33] that catfish reduce their feeding activity at colder temperatures and do not readily come to the surface to feed.

Challenges of weather variables on catfish farming include those external challenges that naturally affect or limit catfish production. This makes catfish farmers in Southwest Nigeria vulnerable to climate change. This observation corroborates the report of Barange *et al*. (2018) [11] that Nigeria is one of the African nations in which their fisheries and aquaculture are particularly vulnerable to climate change and the disasters can be up to 80%. The results showed that 10.6% of the farmers were not aware of any effect of weather on catfish production. But the studies of Adeleke and Omoboyeje (2016), Adebayo (2012), and Aphunu and Nwabeze (2012) [4, 2, 8] confirmed that majority of catfish farmers have the knowledge of the effects of climate change on catfish production and are finding ways to mitigate it.

The results show that weather variables affect biological processes of catfish. This observation corroborates the report of Harrod *et al*. (2018) [18]. It shows that 7.0% of the catfish farmers attributed low breeding results to weather variables, 72.5% of the farmers agreed that weather affects fish feeding habit; they may lose appetite if the temperature is too low. The results showed that 59.9% of

catfish farmers experienced flooding, and 57.7% lost some of their fish to flood. This is the disadvantage of locating fish farms along river course. But this is unavoidable in some cases as mentioned earlier to reduce the cost of water source. Also, 62.0% of the farmers lacked abundant supply of water to produce fish throughout the year. These are classified as short-term climate change impacts on aquaculture (Barange *et al*., 2018) [11].

Likewise, FAO Training manual highlighted the effects of low temperature of pond water on fish to include; slowing down the development of their eggs; reducing the growth of juveniles and older fish; delaying and even preventing their maturation and spawning; decreasing their food intake and even stopping it completely, and increasing their susceptibility to infections and diseases (www.fao.org) [17]. Also, El-Sayed *et al*. (1996) [13] had earlier reported that fish growth was significantly reduced below 21°C and below 10°C, fish will stop feeding and develop severe stress, fungal infection and high mortality. But Abdul-Halim *et al*. (2017) [1] reported that the main components of climate change that would impact fish farming includes high temperature, less rainfall, salinity intrusion, seasonal fluctuation and prolonged drought. This is climate variability due to geographical locations.

In this study, water is presented as friendly-enemy. This is because water is an indispensable resource in fish farming, without which fish cannot survive. But, water can also cause irreparable loss to farmer through flooding. Most farmers like to site their fish farms close to a reliable water source or waterlogged areas. The aim is to supply abundant water all year round. But, there is also the danger of flood. Therefore, care must be taken to construct effective drainage to convey water out quickly to avoid fish loss to flooding.

The third category of challenges is diseases and predators that can attack fish at any stage of life causing enormous economic loss. Disease is highly determined by the state of pond water quality. Disease prevails in polluted fish ponds while predators are many and include human, alligator, snakes, and etcetera. Fish are diseased when there is imbalance reaction between disease causative agents, the water quality (the fish immediate environment) and fish as the host. Effects of diseases can be seen as loss of appetite, isolation, growth retardation, deformity and mortality. Weather or climate change may also contribute to severity of diseases and parasites in fish ponds. Flood may bring in pathogen into the ponds and abrupt change in water temperature may lower fish immunity against disease. This observation is consistent with the report of Barange *et al*. (2018) [11] that climate change may increase risks of diseases, parasites and harmful algal blooms.

The results in Table 3 show that 86.6% of the farmers experienced early morning mortality in the farms, 80.3% of the farmers experienced fish diseases and lost some fish to disease in their farms, and only 49.3% of them could notice fish disease by observation, while 31.0% of the farmers noticed diseases after their fish are dying. Okaeme *et al*. (1987) [26] had earlier confirmed that diseases and parasitic problems could constitute significant economic losses in fish production. Tavares-Dias and Martins (2017) [34] later reported that accurate estimation of economic impacts of parasitic and infectious diseases on production are difficult. However, they estimated direct and indirect economic costs for freshwater farmed fish to be US$ 84 million per year in the Brazilian fish farms. Issa *et al*. (2014) [21] also identified pest and diseases as one the major problems facing catfish production. The most common predator of fish identified was birds; 69% of the farmers agreed that birds prey on their young fish while 25.5% of the farmers identified alligator. Therefore, majority (88.8%) of the farmers covered their ponds with net, some carry out weeding (3.5%) or use chemicals (3.5%), and set traps to get rid of the predators (4.5%). Unwanted fish constitute another form of predation in fish farms, 5.6% of catfish farmers agreed to this.

The fourth category of challenges is security. Fish farms are vulnerable to the sudden attack of thieves mostly when the fish is matured and near or at harvesting period, when farmers are planning to harvest their fish. The

expected profit and the investment capital can be lost within few hours, when farmers least expect the attack. Security challenges involved unlawful entrance of unknown person(s) or individual(s) into a fish farm causing economic damage and loss, and even loss of lives.

The results showed that, 40.1% of catfish farmers experienced poaching or stealing of their fish and 83.8% hired security to guide their farms, 7.0% of the farmers constructed fence round their farms and another 7.0% slept on their farms, providing security by themselves. This is the major reason that catfish farmers form league to construct their ponds together, so that they can bear the security cost together. Adebayo and Daramola (2013), and Olasunkanmi and Yusuf (2014) [3, 28] also identified predators, flood, disease and theft (security) among other challenges facing catfish fish production. The cost of security to fish farms sometimes is another major issue for individual catfish farmers. The issue of security can be securely handled by introduction of clustering fish farming system. This is a situation in which fish famers form a community by coming together at a particular location. They can share some necessary input together, especially, jointly hired security to watch over their fish farms to reduce their individual cost of production.

The fifth category of challenges is the problem of fish marketing which represents the gap between the fish farmers and fish consumers. Fish marketing challenges are the constraints that catfish farmers experience in converting their products to cash, by physical movement of catfish from the point of production to the potential and active consumers. The magnitude of these constraints determines the percentage of harvested catfish that will be sold at breakeven; above breakeven; below breakeven price and/or wasted due to lack of post-harvest facilities. Fish begins to lose quality immediately after harvest. The deterioration continues to increase with time if not processed or consumed, and as a result of this, its price continues to decrease. Lack of post-harvest facilities may even cause fish to lose economic value.

Engle (2010) [14] reported that the marketing challenges are often greater than the production challenges and ultimately more important. The results show that 42.3% of catfish farmers in the study area identified customers buying their catfish on credit as a challenge, 25.4% identified instability of demand and supply of catfish as a challenge, 12.5% identified lack of customers to buy their catfish at profitable price, while 19.8% identified the activities of middlemen and wholesalers as a threat to their profitability. Engle and Stone (2014) [16] cautioned that a small-scale operator must sell fish at retail prices (for example, direct to consumers) to make a profit. Kimathi *et al.* (2013) [22] reported that fish market is one major factor hindering the prosperity of fish farming business which includes where to sell fish. Therefore, Engle (2010) [14] recommended that farmers should analyze the market and marketing before they start fish production.

Marketing challenges can be addressed by formation of fish farmers' marketing groups. Fish farmers may also sell their fish through the help of their cooperative societies (Kimathi *et al*., 2013) [22]. This emphasizes the importance of business plan in fish marketing. Therefore, individual fish farmers should prepare his/her business plan or carry out market survey before production (Engle, 2010) [14].

Farmer should consider the type of species preferred by their target customers, who their competitors are, the form of catfish preferred (fresh or smoked) by customers, the current market price, the quantity of fish demanded by the market, the marketing strategy that should be adopted, and where they will have the highest sales. All these questions must be sincerely answered by the farmer before production of fish starts (Ngugi *et al*., 2007) [25].

Based on the Leadway Assurance (2017) [23] classification of risk facing fish production in Nigeria as pure risks and business risks, in this study, weather and climate change challenges, diseases and predators challenges and security challenges are classified as pure risks, while profitability challenges and

marketing challenges are classified as business risks.

Table 3. Challenges facing Catfish production in Southwest Nigeria

Variables	Frequency (n=400)	Percentage (%)
1.Profitability challenges		
High feed cost	400	100
Not highly profitable	37	9.2
2.Effects of Weather		
No idea	42	10.6
Low breeding result	28	7.0
Loss of appetite	290	72.5
Flooding	240	59.9
Fish lost to flooding	231	57.7
Lack of abundant supply of water	248	62.0
3. Fish diseases and predators		
Early morning mortality	346	86.6
Awareness of fish diseases	321	80.3
Fish lost to disease	321	80.3
Disease notice		
Observation	197	49.3
Death	124	31.0
Predators		
Birds	276	69.0
Alligator	102	25.5
Unwanted fish	22.4	5.5
Prevention from predators		
Cover with net	355	88.8
Weeding	14	3.5
Chemical	14	3.5
Traps	17	4.3
4. Security challenges		
Risky business	284	71.0
Poaching	160	40.0
Farm security		
No security	9	2.3
Hired security	335	83.8
Fenced the farm	28	7.0
Sleeping in the farm	28	7.0
5.Fish marketing challenges		
Buying on credit	169	42.3
Demand/supply	102	25.5
Lack of customers to buy at profitable price	50	12.5
Middlemen/wholesalers	79	19.8

Source: Field Survey, 2019.

CONCLUSIONS

Catfish farming is a profitable business but there are challenges that can limit the profit and even consume the invested capital. Each of these challenges can reduce catfish performance, increase the cost of production, and eventually reduce the profit margin of the business. Lack of technical know-how on the part of fish farm managers contribute to the severity of business risks and challenges. Therefore, fish farmers need to be taught or trained on best ways to handle these risks and challenges for the success of fish farm enterprise. The farmers should take cautions to minimize the effects of pure risks. Moreover, fish farmers should prepare their business plan, analyze the market and evaluate their strengths and opportunities to minimize or eliminate the weaknesses and threats against the profits as a measure of their success in catfish business.

REFERENCES

[1]Abdul-Halim, M. D., Mondal, D. K., Salam, M. A. and Hossain, M. S., 2017, Impacts of climate change on pond fish farming in Amtoli, Borguna, Bangladesh. International Journal of Fisheries and Aquatic Studies, 5(2): 38-41.

[2]Adebayo, O. O., 2012, Climate Change Perception and Adaptation Strategies on Catfish Farming in Oyo State, Nigeria. Global Journal of Science Frontier Research Agriculture and Veterinary Sciences, 2(6):13-19.

[3]Adebayo, O. O., Daramola, O. A., 2013, Economic analysis of catfish (*Clarias gariepinus*) production in Ibadan metropolis. Discourse Journal of Agriculture and Food Sciences, 1(7): 128-134.

[4]Adeleke, M. L., Omoboyeje, V.O., 2016, Effects of Climate Change on Aquaculture Production and Management in Akure Metropolis, Ondo State, Nigeria. Nigerian Journal of Fisheries and Aquaculture, 4(1): 50-58.

[5]Ajagbe, S. O., Ojo-Fakuade, F .F., 2019, Analysis of profitability of catfish production in Ibadan metropolis, Oyo State, Nigeria. Journal of Forestry Research and Management. 16(3): 50-57.

[6]Alawode, O. O., Jinad, A. O., 2014, Evaluation of Technical Efficiency of Catfish Production in Oyo State: A Case Study of Ibadan Metropolis. Journal of Emerging Trends in Educational Research and Policy Studies (JETERAPS), 5(2): 223-231.

[7]Alawode, O. O., Oluwatayo, I. B., 2019, Development Outcomes of Fadama III among Fish Farmers in Nigeria: Evidence from Lagos State. Evaluation and Program Planning, 75: 10–19.

[8]Aphunu, A., Nwabeze, G. O., 2012, Fish Farmers' Perception of Climate change impact on fish production in Delta State, Nigeria. Journal of Agricultural Extension, 16(2):1-13.

[9]Asa, U. A., Obinaju, L. C., 2014, Economics of Catfish Production in Akwa Ibom State, Nigeria.

Global Journal of Management and Business Research: Economics and Commerce, 14(3): 22-28.
[10]Ashley-Dejo, S. S., Olaoye, O. J., Adelaja, O. A., 2017, Analysis of profitability of small-scale catfish farmers in Oyo State, Nigeria. Malaysian Journal of Animal Science, 20(2): 11 – 24.
[11]Barange, M., Bahri, T., Beveridge, M.C.M., Cochrane, K.L., Funge-Smith, S., Poulain, F., eds. 2018, Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options. FAO Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO. 628 pp.
[12]Edet, E. O., Udoe, P. O., Uwah, E. D., 2018, Costs and return analysis of fish farming in Calabar metropolis, Cross River State Nigeria. Global Journal of Agricultural Sciences, 17: 23-31.
[13]El-Sayed, A. M., EI-Ghobashy, A., Al-Amoudi, M., 1996, Effects of pond depth and water temperature on the growth, mortality and body composition of Nile tilapia, *Oreochromis niloticus* (L.) Aquaculture Research, 27: 681 – 687.
[14]Engle, C. R., 2010, Aquaculture Economics and Financing: Management and Analysis. Wiley-Blackwell. 2121 State Avenue, Ames, Iowa 50014–8300, USA Pp. 274. www.wiley.com/wiley-blackwell, Accessed on June 3, 2019.
[15]Engle, C. R., Stone, N. M., 2002, Costs of Small-Scale Catfish Production. Southern Regional Aquaculture Center, SRAC Publication No. 381.
[16]Engle, C. R., Stone, N. M., 2014, Costs of Small-Scale Catfish Production for Direct Sales. Southern Regional Aquaculture Center, SRAC Publication No. 1800, Revision.
[17]Fao.org. Improving pond water quality, www.fao.org/tempref/FI/CDrom/FAO_Training/FAO_Training/General/x6709e/x6709e02.htm, Accessed on August 10, 2019.
[18]Harrod, C., Ramírez, A., Valbo-Jørgensen, J., Funge-Smith, S., 2018, *In*: Barange, M., Bahri, T., Beveridge, M.C.M., Cochrane, K.L., Funge-Smith, S., Poulain, F., eds.. Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options. FAO Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO. 628 pp.
[19]Iheke, O. R., Nwagbara, C., 2014, Profitability and viability of catfish enterprises in Abia State of Nigeria. Journal of Agriculture and Social Research, 14(1): 31-36.
[20]Iruo, F. A., Onyeneke, R. U., Eze, C. C., Uwadoka, C., Igberi, C. O., 2018, Economics of Smallholder Fish Farming to Poverty Alleviation in the Niger Delta Region of Nigeria. Turkish Journal of Fisheries and Aquatic Science, 19(4): 313-329
[21]Issa, F. O., Abdulazeez, M. O., Kezi, D. M., Dare, J. S., Umar, R., 2014, Profitability analysis of small-scale catfish farming in Kaduna State, Nigeria. Journal of Agricultural Extension and Rural Development, 6(8):347-353.
[22]Kimathi, A. N., Ibuathu, C. N., Guyo, H. S., 2013, Factors Affecting Profitability of Fish Farming Under Economic Stimulus Programme in Tigania East District, Meru County, Kenya. Journal of Business and Management, 15(3): 2319-7668. www.iosrjournals.org, Accessed on July 7, 2019.
[23]Leadway Assurance, 2017, What You Need to Know About Risk Management in Fish Farming. http://www.leadway.com/need-know-risk-management-fish-farming/, Accessed on June 8, 2019.
[24]Mohammed, U.S., Iyiola, A.S., Usman, R.K., 2015, Production Analysis of Catfish Farming In Epe Local Government Area of Lagos State, Nigeria. Production, Agriculture and Technology (PAT), 11(2): 153-161.
[25]Ngugi, C., Bowman, J. R., Omolo, B., 2007, A new guide to fish farming in Kenya. Oregon: USAID.
[26]Okaeme, A.N., Obiekezie, A.I., Ogbondeminu, F.S., 1987, The economic impact of diseases and parasitic problems in freshwater fish production. In: 5th Annual Conference of the Fisheries Society of Nigeria (FISON), 22-25 Sep 1986, Ilorin, Nigeria, pp. 368-374.
[27]Okpeke, M. Y., Akarue, B. O., 2015, Analysis of the Profitability of Fish Farming in Warri South Local Government Area of Delta State, Nigeria. Journal of Agriculture and Veterinary Science, 8(12): 45-51.
[28]Olasunkanmi, N. O., Yusuf, O., 2014, Resource use efficiency in small scale catfish farming in Osun State, Nigeria. Sky Journal of Agricultural Research, 3(1):037- 045.
[29]Olayiwola, O. O., 2013, Technical efficiency of fish production in Ijebu-Ode. International Monthly Refereed Journal of Research in Management & Technology, 2(1): 26 -42.
[30]Oluwasola, O., Ige, A. O., 2015, Factors Determining the Profitability of Catfish Production in Ibadan, Oyo State, Nigeria. Sustainable Agriculture Research, 4(4): 57-65.
[31]Onyekuru, N. A., Ihemezie, E. J., Chima, C. C., 2019, Socioeconomic and profitability analysis of catfish production: a case study of Nsukka Local Government Area of Enugu State, Nigeria. Agro-Science, 18 (2): 51-58.
[32]Osawe, O. W., Akinyosoye, V. O., Omonona, B. T., 2008, Technical efficiency of small scale farmers: an application of the stochastic frontier production function to fish farmers in Ibadan Metropolis, Oyo State, Nigeria. Journal of Economics and Rural Development, 16(1): 71-82.
[33]Robinson, E. H., Li, M. H., Martin, W., Brunson, M. W., 1998, Feeding Catfish in Commercial Pond. Southern Regional Aquaculture Center SRAC Publication No. 181
[34]Tavares-Dias, M., Martins, M. L., 2017, An overall estimation of losses caused by diseases in the Brazilian fish farms. Journal of parasitic diseases, 41(4): 913–918.
[35]Tunde, A. B., Kuton, M. P., Oladipo, A. A., Olasunkanmi, L. H., 2015, Economic Analyze of Costs and Return of Fish Farming in Saki-East Local Government Area of Oyo State, Nigeria. Journal of Aquaculture Research and Development, 6(2): 1-5.
[36]Ume, S. I., Ebeniro, L. A., Ochiaka, C. D., Uche F.O., 2016, Economics Analysis of Catfish Production

in Anambra State, Nigeria. International Journal of Environment, Agriculture and Biotechnology, 1(3): 476-481.