International Academic Journal of Empirical Research

Volume 1, Issue 1, Pages 37-47, August, 2015
Type: Double Blind Peer Reviewed International Research Journal
Host: Africa Research Corps (www.africaresearchcorps.com)
Journal Series: Global Academic Research Consortium (garc)
Publisher: iajgr Publishing (USA)

# Effect of Business Environment on Catfish Production in Zone C, Benue State, Nigeria

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*Published by – International Academic Journal for Global Research (iajgr) Publishing (USA):*

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# Effect of Business Environment on Catfish Production in Zone C, Benue State, Nigeria

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## 1. Introduction

Domestic fish production was put at 551,700 metric tones in 2007 as against the national demand of about 1.5 million metric tones estimated for 2007 in Nigerian (Osawe, 2007). The shortfall is said to be bridged by the importation of 680,000 metric tonnes annually consuming about N 50 billion in foreign exchange (Odukwe, 2007).

In the wake of a looming global food crisis, Nigeria is not isolated; more emphasis is now being placed on increased domestic supplies (Emokaro and Ekunwe, 2009). One sure way of doing this is by ensuring the efficiency of catfish farmers in their use of inputs. Catfish is the most commonly cultivated species of fish because of its superior market value (Food and Agriculture Organization (FAO), 1991).

Throughout the centuries, fish has been an important component of the population's diet in many parts of the world (Carballo, Van Eer, Van Schie and Hilbrands, 2008). Research shows that the world's natural stocks of fish and shell fish, though renewable, have finite production limits, which cannot be exceeded even under the best management regimes (Okechi, 2004). Idachaba, Umebese, Akingbade and Adeniyi (1981) highlighted three basic business environment infrastructures (*physical, social and institutional factors*) for improved agriculture performance.

In order to formulate enabling policies that will have the needed impact on catfish enterprises, we must examine critically the roles played by these technical efficiency determinants. The efficient use of resources (inputs) alone, without taking into consideration these business environmental factors, from which these resources are sourced, will always limit efforts to the internal reallocation of resources (inputs). For example, the catfish farmer needs to form coordination partnership with input suppliers, government and relevant stakeholders, so as to get the required quality, credit and quantity of inputs needed for production within the technical-core (production-unit) and at a reasonable price. However, catfish farmers take a lot of risk when the business environment forces are not identified and strategies are not implemented in time to cushion threats from the environment.

### 1.1. Research Question

How does business environment comprising of physical, social and institutional factors influence catfish production in Zone C, Benue State?

### 1.2. Objective of the Study

Examine the influence of business environment which comprises of physical, social and institutional factors on catfish production in Zone C, Benue State

## 2. Literature Review

### 2.1. Concept of Technical Efficiency

This is purely an engineering concept. According to Handerson and Cockburn (1994), the production function differs from the technology in that it pre-supposes technical efficiency and states the maximum output obtainable from every possible input combination. Technical efficiency is measured as a ratio of realized output to the potential output; the reliability of this measure of technical efficiency depends on how accurately the potential output is measured (Karagiannis and Tzouvelekas, 2005). Models used for measurement of technical efficiency can be grouped into three broad categories (Raju, 1987): (1) the programming model described by Boles considered (1) 'n' individual farms as a separate activity producing a unit of output through the input of 'm' factors of production and (2) $j^{th}$ activity described by a vector of (m + 1) elements of inputs. Given the n activities and $j^{th}$ list of inputs his problems is to find out the maximum output that can be produced. The $j^{th}$ activity is inefficient and the efficient index is defined as the reciprocal of maximum output. This can be considered as a linear programming model. (2) Programming mdoel used by Ainger and Chu (1968), suggested as alternative approach in measuring technical efficiency using Cobb-Douglas production function. This does not require the condition of constant returns to scale and reduces to a minimizing linear programming problem. (3) According to Raju (1987), the Density Function Approach (DFA) is an approach, whereby probability statement of the form is used instead of marginal approach.

### 2.2. Concept of Business Environment

The Business environment of catfish production from the broader, all inclusive perspective accommodates physical, social and institutional components. Business environment is seen to contain factors that influence policy decisions and activities of catfish enterprise production-unit (also referred to as the technical core of the enterprise). According to North (1981) the environment is further separated into the physical/ infrastructural environment, institutional environment, and social/economic environment. There are many distinct but similar approaches available in categorizing business environment components. Idachaba *et al.* (1981) identified business environment components into three sets namely physical, social and institutional. A business firm gets human resources, capital, technology, information, energy, and raw materials from society (environment). It follows government rules and regulations, social norms and cultural values, regional treaty and global alignment, economic rules and tax policies of the government. Thus, a business organization is a dynamic entity because it operates in a dynamic business environment (Gluek, 1980).

In order to underscore the importance of environment of agribusiness, consider the situation of a football team, where the environment consists of the opposing team (i.e. competitor), the referee who dictates the game, the weather of the football tournament, the condition of the pitch, the fans, etc. The football manager must first study the opposing team to know their style of play, the kind of players to use for the type of pitch, the character of the referee, etc, before setting out for the tournament. If these elements are properly evaluated, the football team will have a better chance of winning the football match, if the manager's advice is adhered to. The agribusiness manager must likewise understand the basic elements of its environment to properly maneuver them. What is really important is that, the agribusiness manager should know that any factor or variable that is not directly used to produce his output or manage his business, but somehow influences his business objectives constitutes an environment of agribusiness. However, the environment of agribusiness can be defined as those factors, institutions and infrastructures that exist outside the agribusiness firm that affects decisions, objectives and activities of the business. Under the business environment concept, three forces that constitute threat or opportunity to the catfish enterprise will be examined for this study. These forces are: physical, social and institutional factors.

## 3. Methodology

### 3.1. Research Design

This study is a correlational study because data was generated through primary sources to examine the relationship between business environment and catfish production in Benue State. The study is also a descriptive survey study because it involves the examination of the frequency, means, standard deviation and range of the study's variables. However, this study is utilizes cross-sectional data collection because observation was done in short period of time via questionnaire instrument.

### 3.2. Population and Sampling

The population of the study is made of catfish farmers in Benue State. A first attempt at a comprehensive, nationwide inventory of inland water resources was made by the Aquaculture and Inland Fisheries Project (AIFP) of the National Special Program for Food Security (NSPFS). According to this inventory, Benue State has 198 Catfish farms – the highest compared to other Northern States in Nigeria (Food and Agriculture Organization

(FAO), 2007b). The list of catfish farmers in Benue State obtained from FAO (2007b) and Benue State Ministry of Agriculture was distributed across the zones and 43 catfish farmers was drawn for Zone C.

### 3.3. Model Specification

The structure of the General Model (Full Specification Model) is imbedded in the equation linking catfish output to resources (inputs) on one hand (Model 1) and inefficiency model (Model 2) on the other. In the inefficiency model, inefficiency effect is linked with the business environment. Business environment factors are captured, through variables that influence the welfare or performance of the catfish production in the study area. This study will focus on the following business environment factors, i.e. physical, social and institutional factors. In this study, it is assumed that business environment variables have inefficiency effects on the resource use of catfish production in Zone C, Benue State.

$$LogY_i = \beta_0 + \sum_{j=1}^{4} \beta_j \, LogX_{ji} + (V_i - U_i)$$

$$\boldsymbol{lnY} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1 lnFING} + \boldsymbol{\beta_2 lnFEED} + \boldsymbol{\beta_3 lnLABO} + \boldsymbol{\beta_4 lnPOSI} + (\boldsymbol{V_i} - \boldsymbol{U_i}) \text{ .... (Model 1)}$$

*Where:*

Log or ln = the logarithm base 10;

I = sample of catfish enterprises

j = number of inputs and farm-specific variables

Y = represents yield of the catfish enterprises in kg

$FING$ = fingerlings used in production (kg); *a priori* expectation is positive

$FEED$ = quantity of standard feeds used (kg); *a priori* expectation is positive

$LABO$ = labor requirements (man-days); *a priori* expectation is positive

$POSI$ = pond size of fish enterprise ($m^2$); *a priori* expectation is positive

$\beta_j$s = parameters of linear terms; j = 0, 1... 4 are parameters to be estimated

$ln$ = Log of estimated values of inputs, output and error term

$v_i$s = statistical errors and random shocks such as faulty equipments, low quality fish feed, errors in measurement; are assumed to be independent and identically distributed N (0, $\sigma^2$) random variables

$u_i$s = error term measuring the level of inefficiency in production; are assumed to be independent and identically distributed non-negative truncations of the N (μ, $\sigma^2$) distribution.

The **inefficiency model** for the study is shown below;

$$U_i = \delta_0 + \sum_{j=1}^{9} \delta_j \, LogZ_{ji}$$

$$\boldsymbol{U_i} = \boldsymbol{\delta_0} + \boldsymbol{\delta_1 Z_1} + \boldsymbol{\delta_2 Z_2} + \boldsymbol{\delta_3 Z_3} + \cdots + \boldsymbol{\delta_9 Z_9} \text{ ................................. (Model 2)}$$

*Where:*

$U_i$ **=** inefficiency effect

$Z_{ji}$= Explanatory variables for the technical inefficiency effects for the $i^{th}$ farmer,

$\delta_j$s = parameters of demographic and environment of business variables
$Z_1$= Accessible roads to production unit [AROADS] (Dummy: accessible roads to production unit =1, bad roads to production unit=0); *a priori* expectation is positive
$Z_2$= Cost of energy [COSTPF] (₦); *a priori* expectation is negative
$Z_3$= Cost of water storage [COSTSF] (₦); *a priori* expectation is negative
$Z_4$= Number of years spent acquiring formal education [EDUCAT] (yrs); *a priori* expectation is negative
$Z_5$= Years of experience in catfish production business [EXPERI] (yrs); *a priori* expectation is negative
$Z_6$= Access to consultants/veterinary services [ACONS] (Dummy: access to consultants/vets=1, No access to consultants/vets=0); *a priori* expectation is positive
$Z_7$= Credit obtained from financial institutions [CREDIT] (₦); *a priori* expectation is negative
$Z_8$= Cost of innovation/technology in fish production from research institutions [COSTIN] (₦); *a priori* expectation is negative
$Z_9$= Availability of market intermediaries for catfish output [AVLMKT] (Dummy: access to market institution/intermediaries = 1, scarce markets = 0); *a priori* expectation is positive

The generalized likelihood ratio statistic is computed as $\lambda = -2log[L(H_0)/L(H_1)]$, where, $L(H_0)$ and $L(H_1)$ are the likelihood functions evaluated at the restricted and unrestricted maximum likelihood estimator for the parameters. If the null hypothesis, $H_0$, is true, then the statistics has approximately an chi-squared distribution with parameter equal to the number of restriction imposed by $H_0$ and with the degree of freedom equal to the difference between the parameter estimated under $H_1$ and $H_0$ respectively. The value of the γ indicates the relative magnitude of the variance associated, with the distribution of inefficiency effects, $U_i$. If $U_i$ in the stochastic frontier are not present or alternatively, if the variance parameter, γ, associated with the distribution of, $U_i$, has value zero, then, $\sigma_u^2$, in (model1) – (model 2) is zero and the model reduces to a traditional function with the variables, fingerlings, feeds, labor and pond size, all included in the production function meaning that inefficiency effects are not stochastic.

## 4. Results and Discussion

### 4.1. Descriptive Analysis of Business Environment Data on Catfish Production in Zone C, Benue State

The mean catfish yield in Zones C, Benue State is 4.53 Kg/m$^2$ (Table 1). On average, catfish producers used: 0.086 of fingerlings per m$^2$. On average, 5.849kg of feeds per m$^2$ was utilized by catfish producers. The average labor used was, 0.776 man-days per m$^2$. On average, the pond size in m$^2$ utilized by catfish farmers is 582.11. Availability of roads is 61%. Average cost of processing facilities is ₦500.00. The average cost of water storage facilities is ₦11, 600.14. The average number of years spent acquiring formal education is 16.25 years. Average experience in years is 3.61. Percentage of farmers who had access to consultants is 44%. Average access to credit is ₦3, 750.00. The average cost of acquiring technology from research institutions and universities is ₦8, 305.56. Percentage availability of market intermediaries is 44%.

**Table 1:** Resources Data and Business Environment Characteristics in Zone C, Benue State

| Variable | ZONE C (Mean) |
|---|---|
| | **n=36** |
| Y (kg/m$^2$) | 4.534 |
| FING (kg/m$^2$) | 0.086 |
| FEED (kg/m$^2$) | 5.849 |
| LABO (man days/m$^2$) | 0.776 |
| POSI (m$^2$) | 582.11 |
| AROADS (dummy) | 0.61 |
| COSTPF (₦) | 500.00 |
| COSTSF(₦) | 11600.00 |
| EDUCAT (yrs) | 16.25 |
| EXPERI (yrs) | 3.28 |
| ACONS (dummy) | 0.44 |
| CREDIT (₦) | 3750.00 |
| COSTIN (₦) | 8305.56 |
| AVLMKT (dummy) | 0.44 |

***Source:*** Field Study, 2014

### 4.2. Influence of business environment which comprises of physical, Social and institutional factors on catfish production in Zone C, Benue State

The positive coefficients of fingerlings, feeds, labor and pond size in Zone C implies that a unit increase in one of the variables when others are held at fixed levels is consistence, with increase in output levels for catfish yield (see Table 2). This is in tandem with *a priori* expectations. Table 2 indicates over or under utilization of feeds in Zone C. The non-significant of feed, labor and pond size could be as a result of farmers over or under utilizing their resources.

The presence of technical inefficiency on the relationship between catfish business environment and resource use for Zone C, Benue State in estimated gamma (γ) usage is indicated in Table 2. The analysis obtained is 0.0499 for Zone C. The γ coefficient for Zone C was insignificant.

**Table 2:** Estimated Cobb–Douglas Production Frontier Results Across Zones

| | | ZONE C |
|---|---|---|
| | | **(n=36)** |
| Variable | parameters | |
| *Frontier Prod. Function* | | |
| Constant | $\beta_0$ | -0.0691 (0.873) |
| FING (kg/m²) | $\beta_1$ | 0.241 (0.846) |
| FEED (kg/m²) | $\beta_2$ | 0.0811 (0.713) |
| LABO (man days/m²) | $\beta_3$ | 0.147 (0.789) |
| POSI (m²) | $\beta_4$ | 0.719 (0.775) |
| *Inefficiency effects model* | | |
| Constant | $\delta_0$ | -0.0000333 (0.932) |
| AROADS (dummy) | $\delta_1$ | -0.000164 (0.909) |
| COSTPF (₦) | $\delta_2$ | -0.000245 (0.931) |
| COSTSF(₦) | $\delta_3$ | -0.000414 (0.973) |
| EDUCAT (yrs) | $\delta_4$ | -0.000652 (0.863) |
| EXPERI (yrs) | $\delta_5$ | -0.000699 (0.852) |
| ACONS (dummy) | $\delta_6$ | -0.00308 (0.988) |
| CREDIT (₦) | $\delta_7$ | 0.00248 (0.988) |
| COSTIN (₦) | $\delta_8$ | -0.0150 (0.725) |
| AVLMKT (dummy) | $\delta_9$ | -0.000808 (0.849) |
| *Variance parameters* | | |
| Sigma-squared | $\sigma^2$ | 0.00244 (0.257) |
| Gamma | $\gamma$ | 0.0499 (0.946) |
| Log Likelihood | LLF | 65.367 |
| LR test of the one sided error | LR | 8.549 |

This indicates that inefficiency effects are not significant amongst the catfish farms in Zone C. However, if we were to test for hypothesis in Zone C, our decision would be to accept the null hypotheses indicating the absence of inefficiency effects. The technical efficiency is 1.1881 for Zone C. This information tells us that Zone C catfish farmers are operating in stage 1 of the production function.

The Return to Scale (RTS) from the general model consisting of both Cobb-Douglass Stochastic Production Frontier model and the inefficiency model is 1.1881, on the catfish enterprise. This was largely influenced by inefficiency effects from the business environment. This study shows that fingerlings, feeds, labor and pond size utilization by the catfish farmers are operating in stage 1. This study's result is not in tandem with the findings of Ogundari, Ojo and Brummer (2005) in a study of aquaculture in Oyo State with RTS of 0.841. This current study's RTS (1.1881) is also not in accordance with the RTS (0.664) of Emokaro and Ekunwe (2009). The farmers from these two studies operated within stage 2 of the production function, while the catfish farmers in this study are operating in stage 1 as earlier stated.

Procuring fish processing facilities like solar due to epileptic electricity supply helped the farmers to dry (preserve) excess catfish output that are not sold immediately. This is a strategy used by the catfish producer to curb the perturbation arising from energy or electricity supply issue in the study area. Installing storage facilities for water due to unavailability of water supply is another strategy by the catfish manager to reduce the negative influence caused by the water supply issue in the physical environment of business. The theory of change in turbulent times established that managers should reflect organizational competencies to achieve new and innovative forms of competitive advantage despite constraints of path dependencies and previous market positions (Arthur, 1994; Gruca and Nath, 1994; Leonard-Barton, 1992). It also emphasize that, dynamic capabilities result from complicated organizational and strategic routines (Zollo and Winter, 2002) through which managers reconfigure and renew a firm's resource base to generate economically value-creating strategies (Foss, 1996; Pisano, 1994). An increase in the number of years spent acquiring formal education has not improved the level of technical efficiency required in catfish production. This is not surprising because only 9 percent of the respondents have formal education in the area of agriculture. The strategy utilized by only 9 percent of the catfish farmers is that they have either degrees or short-time certified courses in agriculture instead of in other fields of study. An increase in years of experience in catfish production business increases technical inefficiency in this study. This is because only 12 percent of the catfish managers had attended any training or demonstration farms within the last 2 years. Some catfish managers may have only 3 year of experience, but have acquired the latest techniques in modern catfish production. This will be in contrast with a catfish manager, who has 6 years experience in production, but has failed to attend training or demonstration farms within the last 2 years. The strategy used by 12 percent of the catfish producers, is to update themselves regularly on the latest catfish production techniques. The negative coefficient exhibited by variable item in the general model, implies that increase in credit obtained from financial institutions, would lead to a decrease in the level of technical efficiency in the general model. This implies that credit obtained from financial institutions may be too costly. This is because the catfish manager tries to cushion effects from perturbations exhibited by other environment variable items such as procuring fish processing facilities and cost of procuring water storage facilities.

## 5. Conclusion and Recommendations

### 5.1. Conclusion

The study found out that none of the nine business environment variables included in the general model, exerted significant influence on the catfish farm inefficiency level in Zone C, Benue State. However, the availability of markets, accessibility to consultants and accessibility to roads variables exhibited negative signs implying that increased access to these variables lowers the output. This is contrary to *a priori* expectations that increased access to these variables leads to higher productivity.

### 5.2. Recommendations

Based on the findings of this study, the following recommendations are appropriate:

i. In order to have effective control over the inputs resources within the catfish business environment, efforts should be made by academics and managers to identify other environmental factors such as government/political/legal, economic, natural, suppliers, etc, that could pose serious threats.

ii. After identifying challenging business environmental forces, attempts should be made to identify those variable items that are most unstable and find ways to strategize their behavior and achieve stability within the catfish enterprise.

iii. The negative effects from the physical environmental factors are largely due to epileptic power supply and unavailability of water supply within the study area.

iv. Managers could provide alternative sources of energy to reduce the overhead cost incurred in wastes associated with catfish production.

v. Alternatively, the catfish manager could provide alternative sources of water supply like the digging of boreholes or wells to reduce the cost of buying water.

vi. In order to reduce the negative influence from the social factor, catfish farmers should try to acquire a short but intensive agricultural course (especially in catfish production and management) from tertiary institutions.

vii. Improvement in the years of experience in catfish production business could be achieved if catfish managers attend trainings or demonstration farms at least once every year.

viii. Government can help to reduce the cost of obtaining credit from financial institutions, by enacting policies that will reduce or eliminate collateral needed for loans.

ix. Managers of catfish farms should try and enter into contract farming agreements with customers, suppliers and investors in order to acquire inputs without cash.

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**APPENDIX I:** QUESTIONNAIRE DISTRIBUTION AND RETRIEVAL

| | **Number Administered** | **Number Retrieved** | **Acceptance Number** | **% of Success** |
|---|---|---|---|---|
| Zone C, Benue State | 43 | 37 | 36 | 18.2 |