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Impact of Covid-19 Pandemics Lockdown on Catfish Production of Urban Farming Households in Southwest Nigeria

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Abstract
Covid-19 is a novel pandemic that affected all aspects of life most especially the agrarian households in charge of crop and livestock enterprises. The study was carried out to examine the impact of covid-19 lockdown on urban catfish farming households in southwest Nigeria. A total of 196 respondents was drawn using a multistage sampling technique and this was achieved through administering copies of well-structured copies of questionnaires which were administered by trained enumerators during the survey. Parametric tools such as multinomial regression, endogenous switching regression, ordinary least square multiple regression and Likert scale rating were used to identify the management system used, determine the quantity of catfish produced and constraints militating against catfish production. Results revealed that the mean age of catfish farmers, years of experience and monthly income were 47.7 years, 14.4 years and N62, 017.00 respectively. Years of farming experience and acquisition of professional training were found to increase the use of concrete ponds among urban catfish farmers while seasonal revenue increased the use of earthen ponds. It was recommended that plastic and concrete ponds should be recommended for urban catfish farmers for ease of control and seamless seasonal access coupled with a dense urban population.

Keywords: Catfish, Lockdown, Multinomial Logit, Urban, Switching Regression

Introduction

Food itself is not responsible for the transmission of disease to people. According to both the World Health Organization (WHO) and the World Organization for Animal Health (WOAH), the COVID-19 pandemic is being sustained through human-to-human transmission and not through international trade in animals and animal products (Food and Agriculture Organization, 2020). Each stage of the fisheries and aquaculture supply chain is susceptible to being disrupted or stopped by measures arising from COVID-19 restrictions (Peter *et al*, 2013). Only by protecting each stage of the supply chain can the continued availability of fish and fish products be guaranteed. In aquaculture, there is growing evidence that unsold production will result in increasing levels of live fish stocks, creating higher costs for feeding as well as risks of fish mortalities (Ramsden and Harkell, 2020; Santos, 2020). In developing countries with large informal sectors, the lockdown and physical distancing measures have especially impacted vulnerable small-scale and artisanal workers and communities. Many of these workers do not belong to producer organizations that represent their combined interests, making it difficult to access government support (Zhang, 2020). Adequate coverage of the fisheries and aquaculture sector, including informal workers, should be provided.

Before the Covid-19 pandemic, global fisheries and aquaculture production (excluding aquatic plants) reached an all-time record of nearly 179 million tonnes in live weight equivalent (FAO, 2020). Overall capture fisheries, with 96.4 million tonnes represented 54 percent of the total, while aquaculture, with 82.1 million tonnes, accounted for 46 percent (FAO, 2020). For the last three decades, aquaculture has been the main driver of the increase in fish production, but the capture fisheries sector still remains dominant for a number of species and vital for domestic and international food security. Developing countries, mainly in Asia, are by far the predominant producers with China, Indonesia, India, Viet Nam and Peru being the key producers in 2018. Fish is a staple food for many Nigerians accounting for over 40% of the protein sources consumed in the country. The consumption of fish has shown an upward growth trend with an annual consumption of about 3.2 million metric tons of which 2.1 million metric tons are imported each year (National

Bureau of Statistics, 2021). However, since the beginning of the Millennium Nigeria has seen the aquaculture subsector experience growth and development. Nigeria now ranks amongst Africa's largest producers of fish, only second to Egypt, whose aquaculture products have Nigeria as its main African market destination. Nigeria owns significant coastline of 853 km and over 14 million hectares of inland waters with 75% being moderately suitable and about112, 085 km^2 assessed as very suitable for aquaculture production. Aquaculture thrives in most regions of Nigeria but the most active regions are the Southwest, South, Southeast and the North Central (Central Bank of Nigeria, 2021).

Local businesses have developed a strong distribution value chain, allowing Small Medium Enterprises to deliver live or frozen catfish and tilapia products to their destinations. Over 30% of Nigeria forms a suitable market. The total fish demand for Nigeria based on the 2014 population estimate of 180million was 3.32mMt while domestic fish production from Aquaculture, Artisanal and Industrial fisheries for 2014 was 1.123m Mt. Also in 2014, fisheries contributed 0.48% to the Agriculture GDP and contribution to Agriculture to GDP (2014) was 20.24%. o Nigeria has been ranked 68th within the group of 160 countries in terms of fish consumption per capita, 19 places above the position seen 10 years before 2014. Fish consumption per capita reached 13.3 kg in 2017 in Nigeria as compared to the world's average of 20.5 kg in 2017 showing that despite the high consumption in Nigeria, there is still a gap to fill in order to meet up with the global harnessing of the opportunity (FAO, 2021).

Covid-19 is a novel disease and the lockdown imposed on countries globally was evidently unprecedented, view researches had been done on Covid-19 and fish production but the gap to be filled in this study is the impact of lockdown arising from the disease on fish production of urban households. Hence, understanding the determinants of covid-19 lockdown on catfish output in urban households in southwest Nigeria. To achieve this, the following research questions were raised. What are the socioeconomic characteristic of fish farmers? What is the main catfish management system mostly adopted by farmers? What is the effect that covid-19 lockdown has on catfish production among farmers? The specific objectives are to describe the socioeconomic characteristics of the respondents; identify the main catfish management system adopted by farmers and examine the effects of covid-19 lockdown on catfish production among the farmers.

Hypotheses of the Study

H_{01}: There is no significant relationship between the quantity of fish output and the selected socioeconomic characteristics of fish farmers.

H_{02}: There is no significant relationship between catfish output in the areas of lockdown and others.

Methodology

Study Area

The study area was Southwest, Nigeria. It is one of the six geopolitical zones in Nigeria. It is made up of six states namely Lagos, Ogun, Ondo, Ekiti, Osun and Oyo. The region enjoys a tropical climate with two distinct seasons, the rainy season (April-October) and the dry season (November to March). It has a total land area of $77{,}818km^2$ with a population of 28,767,752 and a land-man ratio of $0.003km^2$ (National Population Commission, 2006). Oyo state was created in 1991 with its headquarters in Ibadan. It is bounded in the North by Kwara State, in the West by Republic of Benin, in the East by Osun and in the South by Ogun State. It has a land area of $27{,}249km^2$ with an annual temperature and rainfall of $\pm 27^0C$ and 1760mm respectively. The population of the State according to the National Population Commission (2006) is 5,591,589. Oyo State comprises 33 local government areas and three senatorial districts. It is blessed with fertile land and cuts across three distinct agroecological zones (rainforest, guinea savanna and derived savanna) which enhance the cultivation of diverse cultivation of different kinds of crops. Notable among them are: maize, cassava, cowpea, tomato and pepper. Osun State was created in 1996 and has its headquarters in Osogbo. It lies between longitude 04^0 30' E and latitude 05^0 5'E and latitude 05^0 55' N and 08^0 07'W. It is bounded by Ogun, Kwara, Oyo and Ekiti States in the South, North, West and East respectively. Osun State has a total land area of $14{,}875km^{2.}$ It is located in a tropical forest with a population share of 3,423,535 (NPC, 2006). The State is disaggregated into 30 local government areas (LGAs) for ease of administration and proximity of government to the rural dwellers. Farming is the predominant occupation in the area, and, it is practiced on commercial and subsistence levels. Osun State possesses fertile land which is capable of supporting notable crops like cassava, maize, cocoa, kolanut, cashew and yam among others.

Sources of Data

Data used in this study were from primary sources. This was collected from the fish farmers and this ranged from socioeconomic to core professional and technical information. Among the socioeconomic data generated were age, years of experience, marital status, monthly income, gender and the like. Technical and professional aspects of the data were: type of pond, management method, stock size, labour, feed, drugs, annual output and household monthly expenditure among others.

Instrument of Data Collection

Data used in this study was collected through the use of printed and electronic materials. The printed material used was copies of well-structured questionnaires, while the electronic cell-phone which served the dual purposes of image-capturing and voice-recording. Moreover, the interview guide was used to complement data-collecting instruments.

Sampling Technique

A multistage sampling procedure was used to select fish farmers used in this study. The first stage was the purposive selection of Ondo and Osun States based on strict covid-19 lockdown in the former while the policy was relaxed in the latter and high concentration of catfish farmers under different management systems in both places. Purposive selection of five (5) major towns from each of the states, making a total of ten (10) which forms the second sampling stage. In the third stage, twenty (20) catfish farmers were randomly selected from each of the ten (10) towns with 100 respondents from each of Osun and Oyo States making a total of 200 respondents. In the data analysis, only 196 responses were found to be valid with 96 from Osun State and 100 from Ondo State. Find a detailed breakdown of sample selection in Table 1.

Analytical Technique

Data available were analyzed using parametric and non-parametric tools. The following tools were used, such as: Descriptive statistics (DS), Multinomial Regression, Endogenous Switching Regression (ESR), ordinary least square (OLS) multiple regression and Likert Scale Rating scale.

Descriptive Statistics

Descriptive statistics such as frequency counts mean and percentages were used in describing the socioeconomic characteristics of the catfish farmers in the study area.

Multinomial Logit Regression

MLM is used to analyse the determinants of the management method adopted by the fish farmers during Covid-19 period. Following Damodar and Gujarati (2004), the model is of the form stated below:

$$II_{jk} = \frac{\exp(\beta_k' X_j + \theta' Zjk)}{\sum_{i=1} \exp(\beta_1' \; ? + \theta' Zjl)} \ldots 1$$

Ii_{jk} is the probability that individual j chooses alternative k. X_j represents the characteristics of individual j while Z_{jk} represents the characteristics of the *kth* alternative for individual j. $\beta_1 \ldots \beta_m$ are m unknown regression parameters explaining the household characteristics while θ represents the regression coefficient explaining the characteristics of adopted management method(s) adopted by the respondents. The dependent variables are more than two and are not ordinal in nature; the arrangement can therefore be done in any order preferred. The dominant management method (Earthen) mostly used by the farmer was documented for the analysis.

Q = Management system (Earthen=0; Concrete=1; Plastic=2)

X_1= Educational level (in years)

X_2= Farming experience (in years)

X_3 = Type of pond ownership (Owned=1; Rented=0)

X_4 = Distance to pond (Close =1; Far=0)

X_5 = Total Cost of Input (in Naira)

X_6 = Professional training (Yes=1; No=0)

X_7= Total catfish stocked (in No.)

X_8 = Production season (Wet=1; Dry=0)

X_9 = Flood experience(Yes=1; No=0)

X_{10} = Expected Revenue(in Naira)

X_{11} = Extension contacts(in No)

X_{12} = Cooperative membership (Yes=1; No=0)

X_{13} = Lockdown (Yes =1; No=0)

Endogenous Switching Regression Model

The probit regression was first used to determine the factors that affect the covid-19 lockdown condition of the farmers sampled while the switching regression model was used to correct for sample selection bias which may arise from other interventions that provide multiple services to farmers in addition to credit (Lee 1978, Madalla, 1983). Empirical applications of this model to agriculture include studies by Feder *et al*. (1990); Goetz (1993); Fuglie and Bosch (1995) and Freeman *et al*. (1998). In using the Switching regression model, separate regression equations are used to model the welfare of groups of farmers conditional on a specified criterion function. Four functional forms were used such as linear, semi-log, double log and exponential functional forms. The credit constraint condition of the farmer is described by an unobservable excess demand function of a vector of exogenous household socioeconomic and credit variables. The relationship between excess demand for credit and the vector of the explanatory variable is specified as:

$$I^* = \delta Z_i + \mu_i \ldots 2$$

Where Z is a vector of exogenous variable δ is a vector of parameters and μ is a random disturbance term that is distributed with zero mean and constant variance δ^2.

I, which is the excess demand functions for fertilizer is not observed, but responses from the survey is used to determine those households whose productive activities are constrained if the demand for fertilizer exceeds the supply of credit, that is,

$$I^* > 0$$

These responses are used to define the criterion function which is the observable dichotomous variable l_i where

$$I = 1 \text{ if } I^* = \delta Z_i + \mu_i \geq 0 \ldots 3$$
$$I = 0 \text{ otherwise}$$

The dependent variable in the first stage probit equation is the farmer's fertilizer constraint condition. The variable takes a value of 1 if the farmer is fertilizer constrained and 0 if otherwise. The explanatory variables are continuous and binary.

Probit maximum likelihood estimates is used to estimate the parameter δ in equation (3). It is assumed that var $(U_i) = 1$, since δ is estimable only up to a scale factor. Following Feder *et al* (1990) and Freeman (1989), the welfare of the two groups of farmers is modelled by a reduced form equation specified by:

$$Y_{1t} = \beta_1 X_{1t} + U_{1t} \quad \text{if if} = 1 \ldots 4$$
and,
$$Y_{2t} = \beta_2 X_{2t} + U_{2t} \text{ if } i = 0 \ldots 5$$

Where;
β_1 and β_2 are vector parameters
X_{1i} and X_{2i} are vectors of exogenous variables defined in equations 4 and 5.
U_{1i} and U_{2i} are random disturbance terms
Y_{1i} and Y_{2i} are the per capita expenditure function for fertilizer-constrained and fertilizer-unconstrained farmers respectively.
Ordinary least square (OLS) method is used to estimate the parameters β_s equation (3). The random disturbance terms U_{1i}, U_{2i} and U_i are assumed to have a trivariate normal distribution with zero mean and non-singular covariance matrix. Maximizing the bivariate probit likelihood function is feasible but time-consuming to a two-stage estimation method is used to estimate the systems of equations (2) and (3).

Where ϕ and Φ are the probability density function and the cumulative distribution function respectively. The ratio $\frac{\phi}{\Phi}$ evaluated at $\delta^{l} z_i$ for each 1 is the inverse mills ratio. For convenience, defined as;

$$\lambda_{1i} = \phi(i\delta^{i} z_i)/\phi(\delta^{i} z_i) \text{ and}$$
$$\lambda_{2i} = \phi(i\delta^{i} z_i)/\phi(\delta^{i} z_i) \text{ ... 6}$$

These terms are included in the specification of equation 6 to yield

$$Y_{1t} = \beta_1 X_{1i} + \sigma_{1u}\lambda_{1i} + e_{1i} \quad \text{if } I = 1 \text{ .... 7}$$
$$Y_{2t} = \beta_1 X_{2i} + \sigma_{2u}\lambda_{2i} + e_{2i} \quad \text{if } I = 0 \text{ .... 8}$$

Where e_{1i} and e_{2i}, the new residuals have zero conditional means. These residuals are however heteroskedastic. Therefore, estimating equation (5) by weighted least square (WLS) rather than OLS would give efficient estimates.
Thus the two-stage estimation procedure that is used to estimate the model proceeds as follows: In the first stage, probit maximum likelihood is used to obtain an estimate of δ from equation (2). By substituting the estimated values of δ for δ; estimates are obtained for λ_{1i} and λ_{2i} from equation (4). In the second stage (equation 5) is estimated by WLS using the estimated value λ_{1i} and λ_{2i} as instruments for λ_{1i} and λ_{2i} respectively.

Test of Hypotheses
Student t-test was used in testing the hypothesis used for the study.

$$t = \frac{X_1 - X_2}{S_{x_1 x_2} \cdot \sqrt{\frac{2}{\pi}}} \text{ ... 9}$$

Where

$$S_{x_1 x_2} = \sqrt{\frac{1}{2}} (S_1^2 + S_1^2 \quad \text{... 10}$$

$S_{x_1 x_2}$ is the grand standard deviation (or pooled standard deviation), 1= group one, 2 = group two. The denominator of t is the standard error of the difference between two means. For the significance testing, the degree of freedom for this test is 2n-2 where n is the number of participants.

Results and Discussion
Socioeconomic Characteristics of Catfish Farmers
Table 1 showed the socioeconomic characteristics of fish farmers. Result on the age of farmers revealed that they had an average age of about 48 years. It suggests that catfish farmers are young and active. This result is in tandem with Ngeywo *et al*. (2015) and Ogbonna *et al*. (2018) who established that catfish farmers in their areas of study were in their active and economically productive age. Household size of fish farmers showed that the highest (62.2%) falls within the range of at most 6 members while the average household member is 5, suggesting that, probably because of the urban residents of farmers and proximity to medical advice, the knowledge of family planning was so entrenched and applied among them hence the resultant sizable family size. More so, the high cost of living in the urban is might also be a moderator of family size. This result is at variance with Nkamleu and Manyong (2005) and Amsalu and de Graaff (2007) who strongly affirmed that larger households normally tend to have higher productivity as a result of the availability of more labour, which most times are free, thus increasing the profitability of the venture. Distribution of catfish by educational level showed that the majority (99.5%) were educated while specifically, 55.1% had secondary school education. It could be inferred that the overwhelming majority of catfish farmers are educated and this will give them ample opportunity in accepting technical advice and adoption of innovation without hitch. This agrees with Nkamleu and Adesina (2000), Lareau (2003) and Inoni *et al.* (2017) found that formal education had a positive and significant influence on the decision of farmers that led to higher productivity and profitability. The primary occupation of the respondents revealed that civil servant was highest with 38.3% followed by artisan (30.1%) and traders (23.0%) and farming scoring lowest of 8.6%. It could be inferred from this result that the majority (91.4%) raised catfish as alternative source of income. This agrees with Apata (2012) who reported that most fish farmers had other income generating activities which assist them greatly in the area of fulfilling their household financial obligations. Years of farming experience of catfish farmers was 14.4 years; this suggests that farmers possess substantial years of experience and exposure which was enough to operate the enterprise successfully in terms of efficient mobilization of input for realizing proportional output. Married formed the majority (81.1%) have a strong belief in settling down as husband and wife in order to raise children as a source of family labour and realization of more income for family welfare. This result associates with Ahituv and Lerman (2005) and Agbugba *et al*. (2014) who reported that marital relationship is a positive product of increased business profitability and means of procreation for family labour. Also, Nwosu *et al*. (2013) asserted in their study that majority of the catfish farmers were married. Gender distribution of the respondents showed that males were in the majority by 75% relative to female

counterparts with 25%. Males are into the business probably because of the time and rigour it demands especially at the establishment of the pond and final harvest and clearing of the pond which requires extensive energy commitment. Ngeywo *et al.* (2015) and International Labour Organization-ILO (2016) established that females are very few in the business especially in the developed countries but conversely stated that their lesser involvement affects the booming of the business in the production stage as women have the potential of operating the industry productively. The socioeconomic characteristics results further showed that 69.9% were member's cooperatives, while 30.1% were otherwise. Membership is believed to accord farmers the opportunity of bulk purchase of input at less price and hitch-free access to technical information capable of increasing output when applied according to the researcher's recommendation. This is in line with the findings of Etuk *et al.* (2012) which revealed that social organizations help farmers to have enough farm credit to adopt important technologies. The average monthly income of the respondents was N62, 017.00 which is twice the National Minimum Wage (NMW) approved by the Federal Government of Nigeria. This result suggests that anyone who is into the catfish business is financially better than a government worker thereby indicating that the income from catfish production competes favourably with government payment. Catfish farming has equally been adjudged a profitable venture which translates into income that improves household purchasing power and general welfare (Adeogun *et al.*, 2007; Olagunju *et al*., 2007 and Kudi *et al*., 2008). Catfish farmers using concrete method production were highest with 53.6%, earthen pond (38.3%), and plastic ponds (8.1%). Urban areas, due to high population density reduces the land-man ratio which results in competition for space and scarcity of swampy area for such enterprise, instead, a concrete pond which reduces space need and minimum quantity of water was mostly used by many of the farmers. Ansa (2014) noted that Catfish growth and survival are closely related to management practices.

Multinomial Regression of Determinants of Main Management System Adopted by Catfish Farmers

Determinants of the main management system adopted by the catfish farmers in the study area are presented in Table 3. The Probability of likelihood ratio (31.12) was found to be significantly different from zero at 1%, indicating that the model was fit and appropriate. Pseudo R-square (0.0876) showed the relationship between dependent and independent variables as unbiased and efficient.

Earthen Pond

The result of earthen pond showed that type of ownership was negatively signed and significantly different from zero at 10%, professional training was also negatively signed and significant at 1% and the annual revenue realized from the enterprise was also positively significant at 1%. The result further revealed that annual revenue generated influenced the use of earthen ponds while professional training and type of pond ownership negatively influenced the use of earthen ponds over concrete type. A unit increase in owned pond arrangement will decrease the probability of choosing the management method for the earthen pond by 65.1%, while the probability of catfish farmers with professional training under the earthen pond was decreased by 43.1% and a unit increase in seasonal revenue reduce the probability of using the earthen pond management system by zero.

Plastic Pond

Result of plastic ponds has no significant variable but years of experience, distance to the pond, total cost of production, revenue generated, number of extension contacts and cooperative membership influenced the use of plastic ponds, not even at a 10% level of significance.

Determinants of Catfish Farmer's Output during Covid-19 Lockdown

Table 4 presents the results of the effects of covid-19 lockdown on catfish production. The correlation coefficient rho_1 and rho_2 are -0.9735($p<0.01$) and -0.4671($p<0.1$) respectively and are also found to be significantly different from zero in both cases, that is, cases of riceoutput_0 and upland cultivation. Rho_1 and Rho_2 being negatively and significantly different from zero, the model suggests that individuals lower catfish output in that category than a random individual from the sample would have realized.

The likelihood ratio test for joint independence of the three equations is reported in the last line of the output. The variable sigma, \lnst1, \lnst2, \r1, and \r2 are ancillary parameters used in the maximum likelihood procedure. Sigma_1 and Sigma_2 are the square roots of the variances of the residuals of the regression part of the model, and insignificant is its log. \r1 and \r2 are the transformations of the correlation between the errors from the two equations. The quantity of fish produced by farmers was found to be influenced by the covid-19 lockdown period. The quantity of fish produced was influenced positively by sex1 and the quantity of water by 0.1358($p<0.1$) and 0.3069($p<0.05$) respectively. This result suggests that an increase in the number of male farmers in the enterprise and the quantity of water supplied seasonally will increase catfish output. The effect of lockdown on catfish farmers due to covid-19 pandemic was significantly influenced by sex1, household size, mgt1, pond size, season1and primary occupation. As presented by the results; sex1 (0.8422; $p<0.1$), household size (0.1071; $p<0.05$) and pond size (0.4165; $p<0.1$) revealed that an increase in the variables will increase the effect of lockdown on the catfish farming households. Conversely, the management method adopted (-1.2071; $p<0.05$), season (-0.4267; $p<0.01$), and primary occupation (-0.2483; $p<0.05$) were found to decrease the effect of lock down on the catfish households in the area under study.

Test of Hypotheses

Table 5 shows a t-test relating the quantity of catfish produced to experience, monthly income, and household size. The result showed that the t-values for all the variables were of high magnitude with the highest (52.622) and lowest (27.623) revealing a level of significance of 1 percent which is also explained further by the 2-tailed significance of 0.000($p<0.01$). The relationship was significantly different from zero at 1%, which led to the rejection decision of the null hypothesis and it was concluded that there is a significant relationship between the quantity of catfish produced and age, monthly income, and household size suggesting that all the selected socioeconomic variables favored catfish output.

Table 6 presents the result of the test of a significant relationship between household expenditure and lockdown imposed during the covid-19 period. The t-value for household expenditure was 36.107($p<0.01$) and the t-value for lockdown was 6.699($p<0.01$). Since both values of household expenditure and lockdown were found to be significant at 1% level, the null hypothesis was rejected for the alternative hypothesis. Therefore, there is a significant relationship between covid-19 lockdown and the welfare of catfish farmers. By implication, this was the time that production was confirmed to be low, following shortage and high price of input use among farmers. Based on this, there was low productivity and the little produced commanded low revenue. This owes to the fact that most households who would have been consumers were passive and income available was little, thus, reducing the purchasing power of consumers and in turn low welfare.

Conclusion

Results show that socioeconomic variables significantly affected the output of catfish output and welfare of catfish farmers was also affected by the lockdown introduced in the study area by the government. It was therefore recommended that Catfish farmers in the urban area should be encouraged to make use of the production system that can be conveniently managed within their residence under minimal water need that cannot be affected by limited water supply. Also, Plastic and concrete ponds should be recommended for urban catfish farmers for ease of control and seamless seasonal access.

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References

Adeogu O.A., H.K., Ogunbadejo O.A., Ayinla A., Oresegun O.R., Oguntade A.T. and William S.B. (2007). Urban Aquaculture: Producer Perceptions and Practice in Lagos State, Nigeria. *Middle-East J. Sci. Res*., *2*:21-27.

Agbugba I.K., Ihemezie E.J. and Adam E.A. (2014). Informal Sources of Financing Climate Change Adaptation Amongst Crop Farmers in Nigeria. *International Journal of Agricultural Science, Research and Technology*, *4* (1): 7-13.

Ahituv A. and Lerman R. (2005). How Do Marital Status, Wage Rates, and Work Commitment Interact? Institute for the Study of Labor. Discussion Paper No. 1688

Amsalu A. and de Graaff J. (2007). Determinants of Adoption and Continued Use of Stone Terraces for Soil and Water Conservation in an Ethiopian Highland Watershed. *Ecological Economics*, *61* (3): 294–302.

Ansa E.J. (2014). Challenges and Production Process of Catfish Hatcheries in the Niger Delta region of Nigeria. Technical report. *Nigerian Institute for Oceanography and Marine Research. Pp. 21-25*

Apata, O.M. (2012). Awareness and Adoption of Fish Production Technologies in South Western, Nigeria. *Journal of Emerging Trends in Engineering and Applied Sciences*, *3*(5):819-822.

Central Bank of Nigeria (2021). Annual Statistical Report of the Central Bank of Nigeria, Garki, Federal Capital Territory, Abuja.

Etuk, U. R., Ekanem, J.T. and Cookey, I. M. (2012). Analysis of the Contribution of Green River Project to Agricultural and Rural Development in Rivers State. *African Journal of Agriculture Technology and Environment*, 1(1): 59-64.

Feder, G., Lau, L.J., Lin, J.Y. and Luo, X. (1990). The Relationship Between Credit and Productivity in Chinese Agriculture: A microeconomic model of equilibrium. *American Journal of Agricultural Economics, 72*(5): 1151-1157.

Food and Agriculture Organization (2020). Food Outlook. Biannual Report on Global Food Market. Covid-19. http:////www.fao.org/document/card/en/c/cb1993en/

Freeman, H.A., Ehui, S.K. and Jabbar, M.A. (1998). Credit Constraints and Small Holders Dairy Production in the East African Highlands: Application of Switching Regression Model. *Agricultural Economics* 19: 33-44.

Fuglie, K.O. and Bosch, D. (1995). Economic and Environmental Implications of Soil Nitrogen Testing: A Switching Regression Analysis. *American Journal of Agricultural Economics, 77*(4): 15-19.

Gujarati, D., Porter, D.C. and Gunasekar, S. (2012). Basic Econometrics, Tata McGraw Hill Education Private Limited, New Delhi. Pp. 205-208.

Inoni, O.E., Ogisi, O.D. and Achoja, F.O. (2017). Profitability and Technical Efficiency in Homestead Catfish Production in Delta State, Nigeria. *Economics of Agriculture,* 4: 7-12.

International Labour Organization (2016). Women at Work: Trends 2016, p.7.

Kudi, T.M., Bako, F.P. and Atala, T.K. (2008). Economics of fish production in Kaduna State, Nigeria. *ARPN Journal of Agricultural and Biological Science, 3* (6): 17-21.

Lareau, A. (2003). Unequal Childhoods: Race, Class, and Family Life. University of California Press,

p.2
Lee L. (1978). A Simultaneous Equations Model with Qualitative and Limited Dependent Variables. *International Economic Review,* 19(2): 415-433.
Madalla, G.S. (1983). Limited Dependent and Qualitative Variables in Economics, New York: Cambridge University Press, Pp. 257-291.
Ministry of Information and Culture (2019). Annual Report of the Federal Government of Nigeria, Garki, Abuja, Federal Capital Territory.
National Bureau of Statistics (2021). Annual Statistical Report on Household and Farm Survey. Garki, Federal Capital Territory, Abuja.
National Population Census (2006). National Population Census Report, Federal Government of Nigeria.*www.nigerianstat.gov.ng*
Ngeywo, J., Basweti, E. and Shitandi, A. (2015). Influence of Gender, Age, Marital Status and Farm Size on Coffee Production: A Case of Kisii County, Kenya. *Asian Journal of Agricultural Extension, Economics & Sociology*, 5 (3): 117-125.
Nkamleu, G.B. and Adesina, A.A. (2000). Determinants of Chemical Input Use in Peri-Urban Lowland Systems: Bivariate Probit Analysis in Cameroon. *Agricultural Systems*, 63:111–121.
Nkamleu, G.B. and Manyong V.M. (2005). Factors Affecting the Adoption of Agroforestry Practices by Farmers in Cameroon. Small-scale Forest Economics, *Management and Policy,* 4 (2): 135–148.
Nwosu, P.O., Chukwu, G.O. and Ikeorgu, J.G. (2011). Management of leguminous fallows to improve haplic acrisols of southeastern Nigeria for sustainable cocoyam production. The *Nigerian Journal of Agriculture*, 42:174-181.
Ogbonna, O.I., Onwubuya, E.A. and Akinnagbe, O.M. (2014). Adoption of Green River Project Fish Farming Technologies by Farmers in Niger Delta Region of Nigeria. *Journal of Agricultural Extension,* 18 (1): 34-44.
Olagunju, F.I., Adesiyan, I.O. and Ezekiel A.A (2007). Economic Viability of Cat Fish Production in Oyo State, Nigeria. *J. Hum. Ecol.,* 21 (2): 121-124.
Peter, David, Tran, Nhan, Adam, and Taghrad (2013). Alliance for health policy and systems research and World Health Organization. Implementation research on health: a practical guide. Edited by David Peters. http://apps.who.int/iris/handle/10665/91758.
Ramsden, A. and Harkel, O. (2020). The Impact of Covid-19 on Fisheries and Aquaculture Food Systems Possible Responses, Information Paper, November, 2020. FAO, Rome.
Senders, D. and Haines, A. (2006). Implementation Research is Need to Achieve International Health Goals. *PLos Med*, 3:719-722.
Zhang, Y. (2020). Impact of the Covid-19 Pandemic on Mental Health and Quality of Life Among Local Residents in Liaoning Province, China: A Cross Sectional Study. *International Journal of Environmental Resource Public Health*, 15(4): 45-52.

Figure 1: Map of the Study Area
Source: Ministry of Information and Culture, Osun and Oyo States

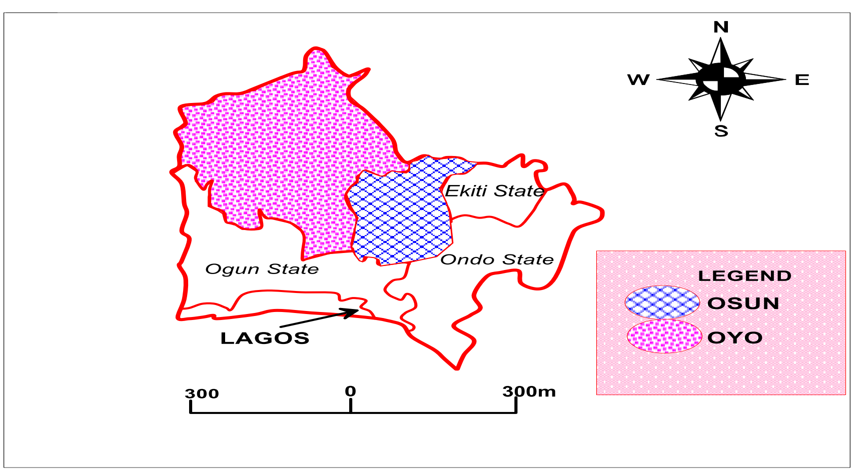

Table 1: Detailed Sampling Procedure for Fish Farmers in the Study Area

First Stage	Second Stage	Third Stage		
State	**Town**	**Respondents Targeted**	**Used Responses**	**Discarded Responses**
Ondo	Akure	20	20	-
	Ondo	20	20	-
	Owo	20	18	2
	Ikare Akoko	20	19	1
	Ilara-Mokin/Ibule	20	19	1
Sub-total:		100	96	
Oyo	Ibadan	20	20	-
	Oyo	20	20	-
	Eruwa	20	20	-
	Ogbomoso	20	20	-
	Shaki	20	20	-
Sun-total		100	100	
Total	-	200	196	4

Source: Field Survey, 2021

Table 2: Socioeconomic Characteristics of Catfish Farmers

Variable	Frequency	Percentage	Mean
Age(in years)			
30	26	13.2	
31-40	35	17.9	47.7 years
41-50	50	25.5	
>50	85	43.4	
Household Size			
6	122	62.2	
7-10	68	34.7	5 members
>10	10	3.1	
Educational Level			
No formal Education	1	0.5	
Primary	39	19.8	-
Secondary	108	55.1	
Tertiary	48	24.5	
Primary Occupation			
Artisan	59	30.1	
Civil Servant	75	38.3	-
Trader	45	23.0	
Farmer	17	8.6	
Farming Experience(in years)			
10	50	25.5	
11-15	82	41.8	14.4 years
16-20	19	9.7	
>20	45	23.0	
Marital Status			
Single	16	8.2	
Married	159	81.1	-
Widowed	14	7.1	
Divorced	7	3.6	
Gender			
Male	147	75.0	-
Female	49	25.0	
Farmer's Cooperative			
Member	137	69.9	-
Non-Member	59	30.1	
Monthly Income(in Naira)			
40,000.00	31	15.8	
41,000.00-60,000.00	65	33.2	N62,017.00
61,000.00-80,000.00	62	31.6	
80,000.00	38	19.4	
Management System			
Earthen	75	38.3	
Concrete	105	53.6	-
Plastic	16	8.1	
Total	196	100.0	-

Source: Computed From Field Data, 2021

Table 3: Multinomial Analysis of Factors Influencing Main Management System Adopted by Catfish Farmers

No. of Obs						196
LR $chi^2(26)$						31.12
Prob>chi2						0.0001
Pseudo R^2						0.0876
Sample Size						196
	Earthen			Plastic		
MgtSys	Coeff.	Std Error	Prob/z/.	Coeff.	Std Error	Prob/z/.
Constant	-1.4905	1.1054	0.178	-2.5758	1.9079	0.177
Education(in years)	0.0586	0.0519	0.258	-0.0270	0.0906	0.766
Farming Experience(in years)	-0.0124	0.0293	0.671	0.0437	0.0480	0.362
Ownership Type	-0.6507*	0.3532	0.065	-0.9710	0.6040	0.108
Distance to Pond	0.0722	0.1020	0.479	0.0698	0.1769	0.693
Total Cost of Production	0.0001	0.0001	0.283	0.0001	0.0001	0.565
Professional Training	-0.4310***	0.1647	0.009	-0.2876	0.2878	0.318
Total Catfish Stocked	-0.0005	0.0004	0.220	-0.0006	0.0007	0.462
Production Season	-0.1686	0.3388	0.619	-0.0069	0.5902	0.991
Seasonal Maintenance Cost	0.2130	0.3062	0.487	-0.2506	0.5851	0.668
Seasonal Revenue	$4.71e^{-07}$***	$2.45e^{-07}$	0.055	$6.58e^{-07}$	$444e^{-07}$	0.138
No. Extension Contact	0.1820	0.3459	0.559	0.5143	0.6053	0.395
Cooperative membership	0.0330	0.3690	0.929	0.6166	0.6122	0.314
Lockdown	0.0245	0.4271	0.954	-1.0390	0.8012	0.195

Source: Computed from Field Data, 2021
Reference category=Concrete ***, **, * rept sig. levels at 1%, 5% & 10% respectively

Table 4: Endogenous Switching Regression Model forEffect of Lockdown on Catfish Production

Log Likelihood	=-204.7491		Wald Chi2	=10.98
No. of Obs	=196		Prob>chi2	=0.1396
Variable	**Coeff.**	**Std. Error**	**z**	**P>/z/**
FishOutput_1				
Constant	8.6071***	1.0627	8.10	0.000
FeedQty	-0.0035	0.0270	-1.29	0.196
Extcontact	0.0014	0.0169	0.09	0.932
FertilizerQty	0.0019	0.0027	0.70	0.485
Experience	-0.0954	0.0931	-1.02	0.306
Sex1	0.1358*	0.0801	1.70	0.090
WaterQty	0.3069**	0.1369	2.24	0.025
DrugQty	-0.0747	0.1058	-0.71	0.480
FishOutput_0				
Constant	7.2304***	2.1655	3.34	0.001
FeedQty	0.0015	0.0083	0.18	0.855
Extcontact	0.0188	0.0288	0.65	0.513
FertilizerQty	-0.0054	0.0082	-0.66	0.506
Experience	-0.1323	0.1579	-0.84	0.402
Sex1	0.0028	0.1352	0.02	0.984
WaterQty	0.3478	0.2604	1.34	0.182
DrugQty	0.2497	0.1735	1.44	0.150
LockDown1				
Constant	1.0598	2.5312	0.42	0.675
FeedQty	1.0598	0.0069	0.66	0.509
FertQty	-0.0029	0.0068	-0.42	0.678
Experience	0.2490	0.2211	1.13	0.260
Sex1	0.8422*	0.5050	1.67	0.095
DrugQty	-0.1293	0.2632	-0.47	0.623
Extcontact	-0.0169	0.0394	-0.43	0.669
WaterQty	-0.3651	0.3195	-1.14	0.253
HHsize	0.1071**	0.0375	2.26	0.024
Mgt1	-1.2071**	0.4997	-2.42	0.016
PondDist	0.4165*	0.2329	1.79	0.074
Season1	-0.4267***	0.1626	-2.62	0.009
PryOccup	-0.2483**	0.1264	-1.96	0.049

/Inst1	-0.7206***	0.0801	-9.00	0.000
/Inst2	-0.6664***	0.1276	-5.22	0.000
/r1	-2.1551***	0.3708	-5.81	0.000
/r2	-0.5064	0.3111	-1.63	0.104
sigma_1	0.4865***	0.0390		
Sigma_2	0.5135***	0.0655		
rho_1	-0.9735***	0.0194		
Rho_2	-0.4671	0.2432		
LR test:	Chi2(1)=13.07	Prob>chi2=0.0003		

Source: Computed From Field Data, 2021

Table 5: Test of Hypothesis

Variable	Test Value =0			
	t	Degree of Freedom	Sig.(2-tailed	Mean Difference
Catfish Output	27.623			1610.00
Experience	51.307	195	0.000	47.74
Monthly income	36.107			62017.35
Household size	52.622			6.04

Source: Computed From Field Data, 2021

Table 6: Test of Hypothesis

Variable	Test Value =0			
	t	Degree of Freedom	Sig.(2-tailed	Mean Difference
Household Expenditure	36.107			62017.346
(Proxy for Welfare)		195	0.000	
Lockdown	6.699			0.561

Source: Computed From Field Data, 2021