Determinants of Institutional Credit Rationing Impact on the Net Farm Income of Catfish Processors in Nigeria

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Summary

This study investigated the effect of catfish processors' socio-economic characteristics on credit rationing, based on primary data obtained from a cross-sectional survey. It also tested whether credit rationing affected the net farm income of catfish processors, using the endogenous switching regression model (ESRM). To account for counterfactual scenarios, the study turned to the results of the causal effects of credit rationing on the net farm income of catfish processors using inverse-probability-weighted regression adjustment (IPWRA) as a robustness check. The results showed that catfish processing was dominated by male processors with an average age of 40 years, where there were six household members, eight years of processing experience and mostly used a combination of traditional and intermediate processing technologies. Loan deployment was at 43.7%, with not less than 67% recovery and 12% default rates. Annual net income from catfish processing was ₦ 2,973,123.86 (8,035.47 USD) with Operating Expense Ratio (OER), Benefit Cost Ratio (BCR) and Return on Investment (ROI) the 0.99, 1.45 and 0.67 respectively. The ESRM results showed that credit rationing is determined by membership of associations, processing experience, years of formal education, frequency of loan requests and interest rate. Furthermore, age of processors, business size, years of formal education, processing experience and catfish selling price influenced net farm income of credit rationed processors. It was concluded that catfish processing was profitable and had a significant impact on the net farm income of catfish processors. The ESRM treatment effect indicated that the average net income per catfish processing farm of non-credit rationed processors was higher than those that were credit rationed. Therefore, the study canvassed for improved group borrowing among processors and advocated that interests of large-scale old catfish processors be protected in bank credit policies. In addition, the existing laissez-faire financial lending agencies should be integrated into formal credit marketplaces via microfinancing to mitigate the impact of credit rationing.

Key words

microfinancing, credit constraint, loan default, ESRM, agribusiness, credit policy, IPWRA

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Introduction

In Nigeria, fish is a cheap source of animal protein when compared to other sources like beef, mutton and chicken (Omowa, 2016; Sogbesan and Kwaji, 2018; Olaleye et al., 2019). In recent times, there has been a tremendous improvement in fish production in Nigeria, such that catfish (*Clarias gariepinus*) alone has grown to account for more than half of 1.02 million metric tons of fish produced annually (FAO, 2016; FDMU, 2016; FAO, 2017; Nigeria Bureau of Statistics, 2017). Yet, the production deficit of over 2 million metric tons of fish is annually serviced by fish imports (Fisheries in Nigeria, 2013; Omowa, 2016; Baruwa and Omodara, 2019). This deficit is partially attributable to limited production capacity and post-harvest losses among other factors (Odediran and Ojebiyi, 2017), as there is a time lag between harvesting and delivery of this highly perishable good to final consumers, which poses preservation problems.

The fish processing sector in Nigeria is dominated by women, with an average age of 43 years, who have at least a primary school education (George et al., 2020) and a low practice of group loan acquisition (Isaac et al., 2020). Financial needs are provided via informal sources in the rural areas. These informal finance providers include moneylenders, rotational savings schemes (esusus), savings collectors, families, friends, cooperative societies, nongovernmental organizations (NGOs), trade, and input suppliers (Buckley, 1997; Iganiga, 2008; Akingunola and Onayemi, 2010). As much as processing is important, meeting market demand, profiting and expanding output is extensively dependent on employing appropriate technologies that measure up to health standard requirements and export certification. Nevertheless, in the absence of sufficient loanable funds/credit, technologies become elusive, irrespective of how advantageous they can be (Asante-Addo et al., 2017; Kofarmata and Danlami, 2019).

The need for credit in Nigerian agriculture is premised on the fact that agricultural investment outlays precede expected returns. Despite the introduction of farmer-friendly credit programmes for easier access to agricultural credit via the Bank of Agriculture and National Insurance and Risk Sharing Agricultural Lending microfinancing, the Nigerian credit market is still troubled by several market imperfections that encourage credit rationing (Rahji and Fakayode, 2009; FMARD, 2016; Ume et al., 2016). Among these market imperfections are factors such as information asymmetry, high loan default risk, loan bureaucracies, servicing costs and the fear of losing collateral and still being indebted (Rahji and Fakayode, 2009; Omonena et al., 2010; Oladimeji, 2018; Amanullah et al., 2019; Kofarmata and Danlami, 2019). Arguably, reasons such as informal lender's expected profits, borrower's socio-economic differentials, human asset endowments, creditworthiness, and interest rates continue to encourage credit rationing (Boucher et al., 2008; Casser and Wydick, 2012; Olomola and Gyimah-Brempong, 2014; Chandio et al., 2017; Elahi et al., 2018; Cao and Li, 2020).

There are empirical studies indicating that decline in household income can be attributed to credit constraints (Omonona et al., 2010; Olomola and Gyimah-Brempong, 2014; Kofarmata and Danlami, 2019; Cao and Le, 2020). Adverse effects of credit constraints may include confining of resource spending and ineffective production preferences due to sub-optimal allocations of other factors of production (Sebakambwe, 2012; Chandio et al., 2017; Elahi et al., 2018; Amanullah et al., 2019; Kofarmata and Danlami, 2019; Cao and Le, 2020). In particular, providing funding for specific, intangible and highly innovative investment such as catfish processing usually faces credit rationing constraints (Rahji and Adeoti, 2011; Sebakambwe, 2012). Removal of credit constraints can therefore enhance gains from farming (Omonena et al., 2010; Sebakambwe, 2012; Asante-Addo et al., 2017; Cao and Le, 2020; Lin et al., 2019; Kofarmata and Danlami, 2019).

A few studies have been conducted to estimate the effects of credit constraints on farm investment and output, either at regional levels or various cropping sub-sectors in Nigeria (Omonena et al., 2010; Olomola and Gyimah-Brempong, 2014; Ojo et al., 2019; Kofarmata and Danlami, 2019; Ojo et al., 2019; Ojo and Baiyegunhi, 2020). To the best of our knowledge, there is no research carried out to estimate the impact of credit constraints on catfish processors' income, especially in the southwestern region of Nigeria. Therefore, this study is uniquely positioned to determine the effects of credit constraints on catfish processor income. Recognizing the importance of credit constraints to the fisheries value chain development, this study aims at identifying the contributions of socio-economic attributes of catfish processors to credit rationing, profiling the lenders' loan statistics for catfish processors, estimating net farm income of catfish processing and determining the impact of credit rationing on net farm income of catfish processors in Osun State. The results of the study would help policymakers identify useful tools to mitigate the impact of credit constraints on the household income, hence transforming the catfish processing subsector through increased credit use in Nigeria.

Theoretical and Conceptual Framework

Theoretical bases for household debt and credit constraints is hinged on the life-cycle hypothesis (LCH) model and the permanent income hypothesis (PIH) of Ando and Modigliani (1963) and Friedman (1957). These theories propound that households borrow to finance current consumption when they are faced with low income, and pay back during the period of high flow of income. When operating in a perfect credit market, households can desire funds to meet financial obligations when due. As such, current consumption would be independent of the current income. However, due to the imperfections associated the capital market, this assumption does not always hold, most importantly in the developing economies where many households are faced with binding credit constraints (Tran, 2014; Amanulla et al., 2019; Kofarmata and Danlami, 2019).

Credit rationing as a phenomenon is both supply and demand related and may occur in several forms including quantity, quality, risk, transaction cost, and price rationing (Stiglitz and Weiss 1981; Petrick, 2004; Boucher et al., 2009). However, quantity rationing is one of the major credit rationing types facing farmers (Sebakambwe, 2012; Amanullah et al., 2019). Petrick (2003) and Boucher et al. (2009) defined credit rationing as a situation where a lack of sufficient credit inhibits desirable investment, since the liquidity problem cannot be solved. This becomes obvious when a demand for credit grows exceedingly more than the available loanable funds and loan contracts are limited to a relatively homogeneous set of borrowers irrespective of the interest rate.

Succinctly put, credit rationing is the "excess demand" of individual borrowers or the similitude of borrower creditworthiness (Petrick, 2004; Casser and Wydick, 2012). Rationing of credit could be due to many reasons (Boucher et al., 2009; Casser and Wydick, 2012). It may be a temporary failure of the credit market that occurs when the amount offered by the lender is less than the borrower's demand for credit due to certain frictions that prevent clearing.

On the other hand, rationing may be an outright rejection of a loan application to forestall adverse selection and moral hazard in an observationally-indistinguishable group irrespective of the offered interest rate (Stiglitz and Weiss, 1981; Allen et al., 2016). In this regard, the rationed borrower may be willing to pay above the optimal interest rate, which, due to the high probability of default, may result in a lower expected return to the lender (Stiglitz and Weiss, 1981; Cassar and Wydick, 2012; Awunyo-Vitor et al., 2014). Similarly, credit rationing may occur when financial intermediaries face liquidity shocks that culminated in increased creditor risk intolerance (Stiglitz and Weiss, 1981; Sebakambwe, 2012; Kofarmata and Danlami, 2019). In addition, in the informal and laissez-faire financial settings, managerial disfunction and inefficient resource allocation, especially under conditions of favouritism, prejudice and corruption, may engender credit rationing (Zhang, 2008; Kofarmata and Danlami, 2019). Here, lenders may favour members of a particular group due to the potential rewards and personal gains. On the other hand, potential borrowers may refuse to seek and request credit based on personal reasons, even if they desire it and their business would be better off with the loan (Awunyo-Vitor et al., 2014).

Credit rationing can be measured using direct and indirect methods (Patrick, 2003; Boucher et al., 2009; Kofarmata and Danlami, 2019). In this study, a direct method is employed to measure quantity rationing. The ratio of quantity of loan a client applied for to the amount of loan granted measures borrowers' quantity rationing. Therefore, credit is rationed if the loan granted is less than the amount applied for, if the borrower has not applied at all, or if a credit request is denied completely (Sebakambwe, 2012; Asante-Addo et al., 2017). Credit rationing is represented by a continuous variable y_c and then categorized into a dummy – "credit rationed" is given a value of 1 and "not credit-rationed" receives a value of 0. The decision to ration credit is made mainly by the lender, and thus, credit rationing is assumed to be a supply related decision (Tran, 2014). However, some of the policies governing credit rationing depend significantly on borrowing records, quantity of loanable funds at the lenders' disposal and borrowers' attributes (Stiglitz and Waiss, 1981). As such, fish processors are assumed to have a reasonable influence on credit supply decisions via their socio-economic records with banks such as business size, enterprise performance records, creditworthiness and credit history (Sebakambwe, 2012; Tran, 2014; Lin et al., 2019). As a result, a link can be established between the lenders' rationing decision, amount rationed and the borrower's investment outcome (net farm income).

Credit rationing is a non-random process. This non-randomness implies that participants could be self-selecting (Nuryartono, 2007; Tran, 2014; Lin et al., 2019). As a result, rationed borrowers tend to possess certain attributes in common that may have an outcome variable effect (Lin et al., 2019). Self-selection may also arise due to similarities in the rationed borrowers' socio-economic attributes and other interventions aside from the credit scheme (Hussain, 2005; Twumasi et al., 2020). Thus, parameter estimates for outcome variables resulting from self-selected sample data could be spurious, inconsistent and unreliable for policy recommendation (Tran, 2014). In this study, due to the self-selecting properties of the credit rationing process, an endogenous switching regression approach is used to address the determinants of credit rationing and its influence on net farm income of catfish processors in Osun State.

Materials and Methods

The study area is Osun State, Nigeria. The state is located between longitudes 4°00'E and 5°04'E and latitudes 6°45'N and 8°15'N in southwestern Nigeria. It covers an area of approximately 14,875 km^2 and is made up of 30 local government areas (LGAs) with over 200 towns and a considerable number of highly urbanized settlements. Osun State is bounded in the west by Oyo State, in the east by Ondo and Ekiti States, in the north by Kwara State and in the south by Ogun. The state runs an agrarian economy with a vast majority of the populace engaged in farming which includes fish production and processing (Baruwa and Omodara, 2019; Olajide and Omonana, 2019 Olajide and Omonana, 2019). The state is divided into six fishery zones and has the highest number of fish farmers in southwestern Nigeria (Olajide and Omonana, 2019).

The data used for this study were explored by conducting a cross-sectional survey. A multistage sampling method was used to elicit information from fish processors and agricultural lending institutions in Osun State. At the first stage, using a typical case-purposive sampling technique, four LGAs were selected from the twenty-eight in the State due to their concentration of catfish farms. Similarly, the second stage involved a purposive selection of a community from each of the four LGAs owing to the prevalence of catfish processors. Ife central, Owode-Ede, Ido-Osun and Ofatedo LGAs were thus selected because catfish farming is one of the main livelihood activities of the residents. At stage three, respondents were stratified into lending institutions and fish processors based on the records of Department of Fisheries, Osun State Ministry of Agriculture for registered catfish processors. A snowball technique was then used to select four microfinance banks from each LGA while random technique was employed to select thirty fish processors from the selected LGAs' registered catfish processors totaling 120 fish processors and 16 agribusiness lending institutions, out of which 10 lending institutions and 110 processors were analysable. Following Ojo and Baiyegunhi (2020), at 95% confidence level and 5% error margin, the sample size was calculated using the sample determination formula explained by Cochran (1977). Based on the total number of catfish processors in the state and the sample size, the interval size was determined by dividing the processors population by the sample size.

Data were collected on the socio-economics of processors, bank lending terms and conditions, borrowers' profiles, loan characteristics and borrower's observable characteristics. Borrowers' profiles included risk profile of either the business or the individuals who borrowed the loan. The loan characteristics was measured by the interest rate and collateral provided by the client. The observable characteristics were measured by the age of the catfish processors, their business size and credit history, and a proxy of the number of times credit was granted in the past. To

validate the reliability of the questionnaire, an initial pilot survey of 12 catfish processors was carried out in the Ile-Ife area of Osun State. Then, information obtained with the instrument was tested for internal reliability using Cronbach's alpha test; the result was satisfactory. This instrument was then applied to survey all the respondents. Data obtained were analysed with mean, standard deviation, budgetary analysis and the endogenous switching regression model.

Endogenous Switching Regression Model (ESRM) Specification

Demand for credit is assumed to be a voluntary decision making process (Ojo et al., 2019). This assumption results in a self-selection problem, which may bias the predictive capacity of the parameter estimates (Ojo and Baiyegunhi, 2020). Endogeneity is the major source of the self-selection property of credit demand, but heterogeneity may arise from other interventions that provide multiple services to farmers in addition to credit (Twumasi et al., 2020). To address the bias, this study employed an approach posed by Hausman (1983) that explicitly accounts for sample endogeneity and heterogeneity bias simultaneously. Following Tran (2014), Nuryartono (2017) and Lin et al. (2019), ESRM is used to correct for the endogeneity and heterogeneity problems associated with self-selecting data gathered on credit rationing, allowing for interactions between credit market participation and other covariates (Ojo and Baiyegunhi, 2019). The procedure consisted of two parts: the first part used a probit model to correct for endogeneity due to self-selection in the determinants of credit rationing where respondents were categorized into credit rationed and non-credit rationed; the second part of the model addressed the influence of credit rationing on the net farm income of catfish processors.

According to Lin et al. (2019), credit constraint affects farm income. Assuming that utility (net farm income) derivable when credit is rationed (constrained) Y_{iR}, is less than when credit is not rationed (not-constrained) Y_{NR}, then (Y_{iR},<). The characteristics of borrowers and farm attributes were observable during the survey; however, the preferred net benefit was not known to the researcher. This latent variable is represented by D^* and expressed as a function of observable attributes Z in this latent variable model:

$$D_I^* = \gamma Zi + e_i, \quad D_I = 1[D_I^*>0], \quad \text{or} \quad D_I = 0[D_I^*<0] \tag{1}$$

where D_I^* is a dummy variable that has a value of one for borrowers that are credit rationed and zero otherwise; γ is the vector of parameters to be estimated; Error term, $e_i|x_t$ is $N(0, \sigma_0^2)$, captures errors of measurement and also factors unobservable to the researcher but known to the borrower; and Z variables are the factors influencing credit rationing such as bank loan policy, household, and farm specific attributes. The second equation establishes the outcome equation for the impact of credit rationing using a net farm income function, expressed in equation (2) as

$$Y=g(Cr, \beta, Z) \tag{2}$$

where Y is the natural log of net farm income of catfish processors, g symbolizes income function, Cr symbolizes credit rationing, β is the vector of parameters to be estimated, and Z represents socio-economic characteristics of processors and farm attributes. The two regimes are then expressed mathematically as:

$$\text{Regime 1: } Y_{iR} = X_i\beta_R + u_{iR} \tag{3a}$$

$$\text{Regime 2: } Y_{iNR} = X_i\beta_{NR} + u_{iNR} \tag{3b}$$

where Y_{iR} and Y_{iNR} are the natural log of net farm income in regime 1 and 2 respectively; X_i represents a vector of predictors that are, hypothetically, the determinants of catfish net farm income; β_R and β_{NR} are parameters for credit rationed and non-credit rationed individuals respectively; u_{iR} and u_{iNR} are the stochastic error terms. These three stochastic error terms u_{iR}, u_{iNR} and e_i were assumed to have trivariate normal distribution with zero mean vector and non-singular covariance matrix given as

$$Cov(u_R, u_{NR}, \text{and } e) = \sum = \begin{bmatrix} \sigma_R^2 & \sigma_{R,NR} & \sigma_{NRe} \\ \sigma_R & \sigma_{NR}^2 & \sigma_{NRe} \\ \sigma_{Re} & \sigma_{R,NRe} & \sigma_e^2 \end{bmatrix} \tag{4}$$

where var $(u_e) = \sigma_e^2$, $cov(u_R, e) = \sigma_{Re}$, $cov(u_{NR}, e) = \sigma_{NRe}$, and $cov(u_R, u_{NR}) = \sigma_{NR,R}$ show the variance of the error terms in var $(u_R) = \sigma_R^2$, var $(u_{NR}) = \sigma_{NR}^2$, represents the variance of the error terms in the generated equations. Consequently, expected value of the error terms u_{iR} and u_{iNR} in eqn (3a) and (3b), conditioned on the criterion of sample selection being non-zero. In other words, when latent characteristics are related to selection bias, the error term e_i of the selection Eqn. (1), correlates with error terms, u_{iR} and u_{iNR} in the generated Eqns. (3a) and (3b). Thereby, coefficients of OLS estimates (β_R and β_{NR}) have sample selection bias (Lee, 1982; Ojo et al., 2019). The truncated error terms, $(u_R|D_i = 1)$ and $(u_{NR}|D_i = 0)$ are then presented in line with Tran (2014):

$$E(u_{NR}|D_i = 0) = E(u_{NR}|e_i \leq -\gamma Z_i) = \sigma_{NRe}\frac{-\theta\left(\frac{\gamma Z_i}{\sigma}\right)}{1-\emptyset\left(\frac{\gamma Z_i}{\sigma}\right)} \equiv \omega_{NRe}\lambda_{NR} \tag{5a}$$

$$E(u_R|D_i = 1) = E(u_R|e_i \geq -\gamma Z_i) = \sigma_{Re}\frac{-\theta\left(\frac{\gamma Z_i}{\sigma}\right)}{1-\emptyset\left(\frac{\gamma Z_i}{\sigma}\right)} \equiv \omega_{Re}\lambda_R \tag{5b}$$

where: $\boldsymbol{\theta}$ and $\boldsymbol{\emptyset}$ are the probability density function (PDF) and cumulative distribution function (CDF) of the standard normal distribution. The ratios of these two functions, $\boldsymbol{\theta}$ and $\boldsymbol{\emptyset}$, evaluated are known as the inverse mill ratios (IMRs), λ_R and λ_{NR} (selectivity terms). This is included in the eqn. (6), the outcome equation to account for selection bias. The IMR shows a correlation between credit rationing and net farm income of catfish processors. Previous studies used a two-stage endogenous switching regression procedure (Ojo et al., 2019; Lin et al., 2019; Ojo and Baiyegunhi, 2020). At the first stage, a probit model for selection equation was estimated and the IMRs λ_{NR}, λ_{NR} were predicted in Eqns. (5a) and (5b) respectively. These IMRs λ_{NR}, λ_{NR} were then added to Eqns. (3a) and (3b) to generate the equations below.

$$Y_{iR} = \varphi_R X_i + \lambda_R\omega_R + u_{iR} + \nu_R \tag{6a}$$

$$Y_{iNR} = \varphi_{NR} X_i + \lambda_{NR}\omega_{NR} + u_{iNR}\ \nu_{NR} \tag{6b}$$

The coefficients λ_R and λ_{NR} give parameter estimates for the covariate terms ω_R and ω_{NR} respectively. However, when estimating λ_R and λ_{NR}, the residual of the two-stage estimates ν_R and ν_{LNR} cannot calculate the standard error accurately, resulting in heteroskedasticity (Ojo et al., 2019). This heteroskedastic error came up in the process of inserting IMR into the general equation. Circumventing this problem, a full information maximum likelihood (FIML) method suggested by Lokshin and Sajaia (2004) was employed for an efficient analysis of ESRM. Here, selection and outcome equations were estimated simultaneously.

The FIML fits the selection Eqn. (1) and generated Eqns. (3a) and (3b) to produce consistent standard errors. Consequently, the λ_R and λ_{NR} in Eqns. (6a) and (6b) becomes homoscedastic. As proposed by Lokshin and Sajaia (2004), the FIML log likelihood function for ESRM is given as:

$$\text{Ln}\,\lambda_i = \sum_{i=1}^{N} \left| \begin{array}{c} \lambda_i t_i \left[LnF\left(\frac{\gamma Z_i + \sigma_R(Y_R - X_{iR}\beta_R/\varphi_R)}{\sqrt{1-\rho i_{Re}{}^2}}\right) + Ln\left(f\left(Y_R - \frac{X_{iR}\beta_R}{\varphi_R}\right)\right)\right] + \\ (1-\lambda_i)t_i \left[Ln\left(1 - F\left(\frac{\gamma Z_i + \sigma_R(Y_R - X_{iR}\beta_R/\varphi_R)}{\sqrt{1-\rho i_{NRe}{}^2}}\right) + Ln\left(f(Y_R - X_{iR}\beta_R/\varphi_R)\right)\right)\right] \end{array} \right|$$

According to Tran (2014) and Abdallah et al. (2108), the coefficient of correlation of the equation must be significant. In other words, covariance of error terms and outcome variable (corr (e,u)=ρ) must be significant. When ρ_{iR} and ρi_{NR} generate alternate signs, borrowers are rationed based on their farm income comparative advantages (Ojo and Baiyegunhi, 2020), which implies that rationed borrowers would have below population average net farm incomes, and this is a negative selection bias. On the other hand, if ρ<0, a positive selection bias exists, indicating that rationed borrowers have above average net farm incomes. If ρ=0, then it implies that borrowers will have net farm income above the population's average whether they are credit rationed or not, but would be better off if they were rationed. The main focus of this study is to use the endogenous switching treatment regression model to determine the counterfactual effect of rationing credit on farm income. The counterfactual effect is the net farm income earned by credit rationed catfish processors of certain socio-economic characteristics that would have been earned if the processors had not been rationed and had the same socio-economic characteristics and vice versa. The difference between Eqns. (3a) and (3b) is the change to net farm income of catfish processors due to credit rationing, which is termed average treatment effect on the treated (ATT):

$$ATT = E(Y_{iR} - Y_{iNR}|D_i = 1) = X_i(\beta_{iR} - \beta_{iNR}) + (\sigma_{iRe} - \sigma_{iNRe})\lambda_R \quad (7)$$

As given in Eqn. (3), $E(Y_{iR}|D_i = 1) = X_i\beta_{iR} - \sigma_{iRe}$, indicates the expected outcome for the credit rationed, whereas $E(Y_{iNR}|D_i = 1) = X_i\beta_{iNR} - \sigma_{iNRe}$, represents the expected outcome for the non-credit rationed.

Results and Discussion

Socio-Economic Characteristics of the Smallholder Catfish Processors

The result in Table 1 shows that 48% of the borrowers were rationed and 58% were male. This signifies that almost half of the borrowers were rationed and fish processing is dominated by the male gender in the study area; however, female processors were duly represented in this study. The report disagrees with the submission of George et al. (2020) but complies with findings by Sebakambwe (2012); Tran (2014) and Olajide and Omonona (2019), who reported male dominance in Nigerian catfish farming and that in Rwanda, 64% of farmers in the formal credit market were credit constrained. Further examination in relation to credit rationing status showed that 57.8% and 43.0% of male and female processors respectively, were credit rationed as opposed to the general belief that males have greater admittance to credit than their female counterparts. The average age and years of education of the processors were 40.32±1.19 years and 12.27±0.44 years respectively. Education at higher levels was well spread, which is expected to assist in making better financial decisions significant to maintaining a good profit level. This implies that processors were mature with the capability and platform to seek, obtain, utilise and pay back credit loans in due time; and they had also learned enough to adopt new technologies and innovations that can enhance farm income. This submission collaborated findings by Olajide and Omonona (2019) that significant proportion of Nigerian catfish farmers have tertiary education degrees.

In respect to inclusive social participation and managerial capacity among catfish processors, about 64% of the borrowers belonged to cooperative/farmer groups and 61% had gone through training on catfish processing. These processors had an average of 5.62±0.31 members per household with 7.97±0.61 years mean processing experience.

In terms of firm size and processing capacity, catfish processors were small sized and sold a unit of processed catfish at ₦934.41± ₦44.46 (2.52±0.12 USD). Table 1 reveals that the average processor had about 2.78±0.22 processing outlets and processed 31.79±45.02 units of catfish per day. The majority of the catfish processors used both the traditional and intermediate processing technologies (1.87±0.11). About 78% of the processors accessed credit as individuals (1.57±0.06) and borrowers and had requested for loans not less than 2.38±0.13 times. The frequency of loan request is low, meaning that most processors were likely new bank clients. Credit source is mixed, as the majority of the borrowers patronized the informal credit sector (1.57±0.50). According to Table 1, not less than 95% of the borrowers had a credit history with the lending institution and loans attracted a 15% average interest rate. Having a credit history could mean that a handful of the borrowers were creditworthy.

Catfish Processor's Loan Statistics among the Lending Institutions

Table 2 presents loan statistics for agricultural lending institutions in the study area for the operating year 2017. The report shows that on average, lenders issued a total loan of ₦3,125,002.88 (8,445.95 USD) at a 43.7% disbursement rate. Not less than 67.38% and 11.6% of the loans were recovered and defaulted respectively. For the amount of loans issued, 72.9% were paid out within the scheduled period, whereas 14.5% were either delayed or not paid out at all. Less than 41% of collaterals met loan requirements (40.8%) and 65% of the repeated loans were granted. Loan attributes in respect to loan term shows that issuers charged an average of 11.95%, 10.00% and 11.83% interest on short, medium and long term loans respectively. The medium term loan commanded a lower interest rate, probably to encourage borrowers to invest in portfolios that are capable of expanding the farm asset base such as processing technology. For short, medium and long term loans respectively, the maximum amounts for issuable loans were ₦2,105,000.00 (5,689.19 USD), ₦6,333,333.33 (17,117,12 USD) and ₦20,666,666.67 (55,855.86 USD) for durations of one, two and eight years with loan repayment periods of six, 23, 76 months. The amounts, compared to the fund demands among catfish farmers are ridiculously small. The major given explanation for small loan capacity was limited loanable funds and distaste for agribusiness loans among commercial banks. Despite the continuous campaign for private-public partnership in agricultural financing, commercial banks commit little funds to agribusiness due to stringent loan requirements and rationing.

Table 1. Definition and summary statistics of variables used in the model

Variable	Description of variable	Mean	Std. Dev.
Dependent variable			
RATIONING	Credit rationing (1=credit-rationed, 0=non-credit rationed)	0.48	0.06
Explanatory variables			
GENDER	Gender of processor (1=male, 0=female)	0.58	0.06
AGE	Age of processor (years)	40.32	1.19
MEMBER	Membership of cooperative/farmer groups (1=belong, 0=not-belong)	0.64	0.05
EDU	Years spent in acquiring education	12.27	0.44
TRAINING	Training in catfish processing (1=trained, 0=not-trained)	0.61	0.06
NHSZ	Number of household size (count)	5.62	0.31
EXP	Experience in catfish processing (years)	7.97	0.61
BIS. SIZE	Number of catfish processing outlets (count)	2.78	0.22
CAPACITY	Processing capacity per day (unit/day)	31.79	45.02
TECH	Type of processing technology used (1=traditional, 2=intermediate, 3=modern)	1.87	0.11
PRICE	Catfish price per unit (naira)	934.41	44.46
TYPE	Type of credit (1=individual, 2= grouped)	1.58	0.06
FREQUENCY	Frequency of credit request as a processor (count)	2.38	0.13
SOURCE	Sources of credit (1=formal, 2=informal)	1.57	0.50
HISTORY	Credit history (1=yes, 0=no)	0.95	0.02
INTEREST	Credit interest rate (ratio)	0.15	0.01

Source: Field survey, 2017

These findings support submissions by Rahji and Adeoti (2011) and Salami and Arawomo (2013), that financial institutions commit less than 5% of their loan portfolios to agriculture.

Net Farm Income of Catfish Processing

Table 3 shows the breakdown of the net farm income accrued to processing of catfish per production year 2017. According to the table, catfish processors spent on annual average, a total variable cost of ₦5,907,730.58 (15,966.84 USD), which represents 98.9% of total cost. Raw fish cost alone accounted for 77.1% of total variable costs, followed by cost of packaging materials (14.5%) and then labour cost (3.6%). The annual net farm income was ₦2,973,123.86 (8,035.47 USD). This submission supports the findings by Omowa (2016), that the marking margin of processed catfish was up to ₦89,095.25 per ton (247.47 USD). On a monthly basis, catfish processors earned an equivalent of ₦247,760.32 (669.62 USD). With an average workforce per processor of four, this earning capacity is far above the current national minimum wage of ₦30,000.00 (81.08 USD) in Nigeria and an indication that catfish processing is a very lucrative venture that could end poverty in this nation. Table 3 further reveals that operating expense ratio was 0.99. From this, it is clear that for every ₦100.00 (0.27 USD) invested in catfish processing, processors spent about ₦99.00 (0.26 USD) on operating inputs alone. This is an indication that operating expenses in catfish processing are high and may require borrowed funds to meet processing obligations when due. Similarly, benefit cost ratio and returns on investment were 1.45 and 0.67, which reveals that for every ₦100.00 (0.27 USD) investment made in catfish processing, an average gain of ₦45.00 (0.12 USD) is earned, amounting to 67% returns per production cycle. The returns on capital invested are far higher than the conventional interest rate (15.00%) on loans in Nigeria and should encourage commitments from potential investors, including lending institutions, to grant loans to processors. This submission is in line with findings by Omowa (2016) and Olaleye et al. (2019) that catfish has a benefit-cost ratio above 1.00 and yields 27-79% ROI per kilogram for wholesalers and retailers respectively.

Table 2. Bank loan statistics in the study area

Loan characteristics	Value		
Average total loan issued (₦)	3,125,002.88		
Average disbursement rate (%)	43.70		
Loan recovery rate (%)	67.38		
Loan default rate (%)	11.60		
Rate of payment within schedule (%)	72.90		
Rate of delayed but paid up payment (%)	14.50		
Rate of over-aged loans (%)	1.40		
Rate at which collaterals met loan requirements (%)	40.80		
Rate repeated loans were granted (%)	65.00		
Loan term	Short term	Medium term	Long term
Interest rates loans (%)	11.95	10.00	11.83
Maximum amount issuable loan (₦)	2,105,000.00	6,333,333.33	20,666,666.67
Duration of loan (years)	1	2	8
Loan's repayment periods (months)	6	23	76

Source: Field survey, 2017

Full Information Maximum Likelihood Estimate (FIMLE) of the Endogenous Switching Regression Model (ESRM)

The ESRM is used in this study as an impact model because it is capable of eliminating all confoundedness resulting from self-selection in the sample. According to Table 4, correlation coefficients rho_1 and rho_2 had negative signs, but rho_1 was statistically significant for correlation between non-rationed borrowers and net farm income but might not have the same impact on rationed borrowers, if they were not credit rationed. We can conclude that a credit rationed processor had a lower farm income than a random processor. The significance of likelihood ratio indicates that the three equations should not be estimated separately, thus the use of the endogenous switching model is better than the endogenous model. The null hypothesis that credit rationing does not have an impact on net farm income of catfish processing is rejected and thus, the alternative hypothesis that credit rationing impacts the net farm income of catfish processing is accepted. The result supports the submission by Dong et al. (2010), Tran (2014), Lin et al. (2019) and Cao and Le (2020) that credit constraint has detrimental effects on farm investment and household income.

Determinants of Credit Rationing in Catfish Processing

As given in Table 4, the model in column two shows the determinants of credit rationing. In all, the result shows that coefficients of membership of association, years spent acquiring education, frequency of loan requests and loan interest rate were statistically significant socio-economic factors influencing credit rationing. The model shows that young farmers, who are highly educated, have long processing experience with a low frequency of credit application are more likely to be credit rationed.

Membership of cooperative/farmer groups is a proxy for social capital and had a negative but significant relationship with credit rationing. This result shows that there are low tendencies that processors who have good social capital/networks could be credit rationed. It is reasonable to say that during borrowing, processors that belong to farmer groups may probably leverage on their membership status to get full loan amounts due to collateral benefits of participation. In addition, group formation may lower information barriers and loan transaction costs that induce rationing. Members with institutional lending skills can help their fellows with loan application processing that may decrease processing costs. Thus, group loan practice could be an effective tool and a proactive means to minimize collateral and information barriers associated with credit rationing among catfish processors. There have been growing policy campaigns for farmers' organizations to boost agricultural lending in Nigeria. This finding therefore does not only support group loans, but further submits that socio-inclusiveness plays an important role in overcoming credit constraint in catfish farming. This study agrees with findings by Sebakambwe (2012), Asante-Addo et al. (2017) and Kofarmata and Danlami (2019) that membership of associations reduces borrowers' quality rationing.

Similarly, as proxies for creditworthiness, frequency of loan request and credit history had significantly negative and positive correlations with credit rationing respectively. The result signifies

that increasing the frequency of loan request will lower the probability of being credit rationed. This relationship also depicts that the better the records catfish processors have with lending agencies, the better their tendencies to get full loans than those new to the lending institutions or without credit history. This is probably as a result of increased creditor risk intolerance resulting from changes in available loanable funds at a point in time (Stiglitz and Weiss 1981; Sebakambwe, 2012; Allen et al., 2016).

On the other hand, years spent in acquiring formal education had a positive correlation with credit rationing and disagreed with the "a priori" expectation. The implication is that highly educated processors are more likely to be credit rationed than less educated counterparts. The positive influence of education on rationing is attributable to the existence of few formal financial intermediaries for agribusiness development in the study area (Table 1). Consequently, highly educated processors may patronize formal lending agencies for loans above their stipulated credit limit more often than the less educated processors. As a result, they are more likely to be susceptible to credit rationing and thus, have greater tendencies to employ owned capital for farming than their less educated counterparts. This report is consistent with submissions by Kofarmata and Danlami (2019), but contradicted the findings by Nuryartono (2007), and Cao and Li (2020) that education has a negative correlation with credit rationing. Similarly, contrary to the "a priori" expectation, the coefficient of experience in catfish processing had a positive correlation with credit rationing. The higher the number of years spent in catfish processing, the higher the likelihood that a catfish processor will be credit rationed. What this means is that years of experience is a proxy for borrowers' managerial ability, which needs to be taken into consideration when issuing loans. This report disagrees with findings by Kofarmata and Danlami (2019), who reported that credit constraint declined the tendencies that farmers would be quantity rationed.

On the other hand, interest rate had a positive and significant correlation with credit rationing in line with "a priori" expectation. This means that there is a high tendency that as the given interest rate increases, some borrowers will become credit rationed (Kumar et al., 2020). Allen et al. (2016) stated that the size of the adverse selection premium faced by low risk borrowers will rise with each interest rate increase and a high possibility of loan default will cause rationed borrowers willing to pay above the optimal interest rate. The rationing may even be as a result of the withdrawal of requests due to high interest rates (Cassar and Wydick, 2012; Awunyo-Vitor et al., 2014). This finding aligns with the submission of Olomola and Gyimah-Brempong (2014), who found a positive relationship between credit rationing and interest rate in loan demand of smallholder farmers in Nigeria.

Table 3. Budgetary analysis showing average net farm income of catfish in 2017

Variable	Value/processor (₦)	% fixed cost cont.
Total Revenue (TR)	8946078.50	
Raw fish cost	4606592.52	77.1
Fuel cost	164080.93	2.7
Hired & family labour (man-day)	215,046.72	3.6
Processing materials	55,816.81	0.9
Packing materials	866,193.60	14.5
Total Variable Cost (TVC)	5,907,730.58	98.9
Land rent	25,050.28	1.6
Depreciation cost	40,173.78	2.5
Total Fixed Cost	65,224.06	4.1
Total Cost	5,972,954.64	
Gross Margin (TR – TVC)	3,038,347.92	
Net farm income (GM – TFC)	2,973,123.86	
Benefit Cost Ratio (BCR)	1.45	
Operating Expense Ratio (OER)	0.99	
Returns on Investment (ROI)	0.67	

Source: Field survey, 2017 Currency Conversion rate: ₦360 = 1.00USD

Table 4. Full information likelihood estimates for determinants of credit rationing and its impact on net farm income of catfish processors in Osun State

Variable	Credit rationing		Impact of rationing on NFI			
			Credit rationed		Not credit rationed	
	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
AGE	00.000	0.016	-0.017**	0.016	0.015	0.011
MEM	-0.628*	0.299	-0.193	0.286	1.238*	0.232
EDU	0.126*	0.046	0.025**	0.044	-0.028	0.033
TRAINING	-0.066	0.315	-0.279	0.315	0.455**	0.228
EXP	0.154*	0.040	0.079**	0.038	-0.087*	0.031
BIS. SIZE	-0.043	0.082	0.143***	0.083	0.192*	0.051
PRICE	0.037	0.320	1.824*	0.332	0.879*	0.180
FREQ	-0.370*	0.135	-0.083	0.134	-0.058	0.091
HISTORY	0.047	0.656	0.517	0.649	0.042*	0.486
INTEREST	8.355*	2.109	-1.562	1.683	11.748*	2.776
SOURCE	0.123	0.080				
CONSTANT	-3.116*	2.205	0.123*	0.080	8.705*	1.362
/lns1	-0.004	0.122	-0.040	0.971	-0.243	0.234
/lns2	-0.429*	0.113	-3.790	0.000	-0.652	-0.207
/r1	-7.362*	3.453	-2.130	0.033	-14.131	-0.594
/r2	-0.924	.	.	.	.	.
sigma_1	0.996	0.121				
sigma_2	0.651	0.074				
rho_1	-1.000	0.000				
rho_2	-0.728					
LR test of indep						
Prob > chi2	0.000*					

Source: Field survey, 2017

Impact of Credit Rationing on Net Farm Income of Catfish Processing

At the second stage of the ESRM, the impact of credit rationing on net farm income of credit rationed and non-credit rationed processors was analysed and is presented in Table 4. The result of credit rationed processors reveals that coefficients of age of processors, years spent in acquiring formal education, processing experience, business size and selling price of catfish were statistically significant. On the other hand, coefficients of membership of association, formal training, years of experience, business size, catfish selling price, credit history and interest rate influenced net farm income of non-credit rationed catfish processors and these factors were statistically significant.

Table 4 shows the difference in the significance of socio-economic characteristics between credit rationed and non-rationed processors. The insignificance of age of processors and years spent in acquiring formal education for non-rationed processors and the significance of these two variables for rationed processors are indications that for the credit condition, processors that are young, have higher levels of education increase catfish

net farm income significantly. Similarly, the insignificance of membership of association, formal training, credit history and credit interest for credit rationed processors and significance of these four variables for non-rationed processors are indications that the role of these variables in improving net farm income of rationed processors is negligible.

Table 4 also reveals that additional experience in catfish processing decreases net farm income of non-rationed processors (8.7%) more than it increases net farm income of rationed processors (7.9%). In other words, processing experience has a significantly positive influence in explaining variations in the net farm income of credit constrained and a negative influence on net farm income of unconstrained processors.

This indicates that experienced processors may underuse borrowed funds more than the inexperienced ones. Perhaps, there is a likelihood that as processors grow in experience, a higher proportion of borrowed funds may be diverted to non-farm purposes if credit requests are granted in full. This then suggests that some experienced processors make agricultural credit requests in excess of farm financial needs, which may be channeled into non-profitable ventures. This notion is supported by Kofarmata and Danlami (2019).

Similarly, as a proxy for farm wealth, a unit expansion in business size of borrowers increases net farm income of rationed and non-rationed processors by 14.3% and 19.2% respectively. This means that regardless of processing capacity, net farm income of credit rationed processors will increase. There is an evidence that small firms are more likely to be credit constrained (Lin et al., 2019) because farm size is a collateral asset. However, in this regard, processing capacity is a working capital and may not be acceptable as collateral. This submission agrees with a study by Abdallah et al. (2018), who reported that farm asset did not matter in the household's possibility of being credit constrained or not. Furthermore, a unit rise in the catfish selling price will increase net farm income of both the rationed and non-rationed processors by 182% and 87.9% respectively. Obviously, economics of size may provide a reasonable explanation for the observed difference in the income growth rate of the two groups. Following this, it is deduced that rationed processors are more likely to operate larger businesses than the non-rationed processors. As expected, the higher the selling price, the higher the expected profit from sale. However, irrespective of the credit status, selling price independently influences net farm income of catfish processors.

On the other hand, the membership of association coefficient, another proxy for farm wealth, was positively correlated with net farm income of only the non-credit rationed catfish processors. The result revealed that if there was a 1.0% increase in the rate of non-credit rationed catfish processors belonging to cooperatives/farmers groups, there would be a corresponding 124% boost in net farm income earned from catfish farming. This implies that there are certain benefits unique to non-credit rationed catfish processors that aid credit use efficiency. These benefits may include farmers' training and farm information on better management techniques. Therefore, whether a processor belongs to any association or not, credit rationing does not influence net farm income of rationed catfish processors. The findings contradicted studies by Abdallah et al. (2018) that membership of farmer groups does not seem to influence farm income of non-credit rationed farmers.

Furthermore, the coefficient of processor age had a negative correlation with net farm income of only the credit rationed borrowers. If there is 1.0% increase in the age of credit rationed borrowers, the net farm income of rationed catfish processors will decrease by about 1.7%. This suggests that credit rationing impacts more negatively on net farm income of prime-aged than young borrowers, probably due to the farm management practice differentials. This study therefore disagrees with findings by Lin et al. (2019) that credit rationing affects income of young farmers more than it does old processors. Recall that the average sample age of catfish processors is 40 years, meaning there are a handful of prime-aged individuals among the processors. Going by this, unless pragmatic decisions are made to address this issue, rationing of credit will continue to harm agribusiness growth in the study area.

Similarly, the coefficient of years spent in acquiring formal education had a positive influence on variation in net farm income of only the rationed catfish processors. In this instance, if processors' level of education improves by 1.0%, there will be about a 2.5% increase in the net farm income earned from catfish processing by credit rationed borrowers. Despite credit rationing, highly educated farmers have a better livelihood enabling an increase in farm income than less educated ones. Thus, farm income of the less educated processors is more likely to be affected by credit rationing in the study area. Congruently, lenders are enjoined to take cognizance of borrowers' education when issuing credit and, in the event of rationing, requests from farmers with little education should be given priority to improve their farm income capacity. This submission supports one by Abdallah et al. (2018) that literacy has a positive impact on the farm income of only credit-constrained farmers.

In the same way, the coefficient of formal training had a positive influence only on net farm income of the catfish processors that were not credit rationed. The report shows that if borrowers receive 1.0% additional processing training, their net farm income will be boosted by 45.5%, but only if they are not credit rationed. The implication is that unrationed borrowers who have undergone catfish management training will use credit more judiciously than those who have not. Thus, availability of funds to farmers is an essential tool to optimize managerial skill in catfish processing; however, whether a processor has formal training or not, credit rationing does not inhibit the rewards accrued to good managerial skills among catfish farmers. Furthermore, the coefficient of credit history, a proxy for the number of times loans were received from the issuing agency in the past, had a significantly positive correlation with net farm income of only the non-credit rationed processors. If credit history improves by 1.0%, then there will be a 4.2% corresponding rise in net farm income of non-rationed processors. This suggests that non-rationed processors who have a good credit history with lending institutions possess better capacities to use credit more effectively than those with poor credit history. Thus, improving borrowers' creditworthiness may likely influence net farm income of non-rationed catfish processors. However, irrespective of credit status, credit history independently affects the net farm income of catfish processors in the study area.

Moreover, according to Table 4, the coefficient of interest rate had a significantly negative influence on net farm income of non-rationed processors. Thus, 1.0% increase in the interest rate of

non-rationed catfish processors decreases their net farm income elevenfold. This implies that interest rate is a sensitive factor in catfish processing. However, whether a processor is credit rationed or not, interest rate has an independent correlation with the net farm income of catfish processors in Osun State.

Estimated Impact of Credit Rationing on Net Farm Income of Catfish Processors

The primary focus of this study is presented in Table 5. The results show a negative and significant effect of credit rationing on net farm income. Simply noting a considerable difference between catfish processors that are credit constrained and non-constrained in impact evaluation studies is misleading, as they usually fail to control for potential differences in the characteristics between the two groups. The estimate from the endogenous switching regression model can also be inadequate, even if not misleading, though it accounts for endogeneity. This is because direct coefficients from the model cannot be considered as ATT, since the issue of missing data (counterfactual scenario) has not been accounted for. To account for this, the study turned to the results of the causal effects of credit rationing on net farm income of catfish processors using average treatment effect (ATE) and ATT, where the endogenous treatment was used and complimented with inverse-probability-weighted regression adjustment (IPWRA) as a robustness check. Hence, the estimates from the endogenous switching regression model are discussed. Both ATE and ATT were estimated after fitting the endogenous switching regression with endogenous treatment effects.[1] As indicated in Table 5, the estimated potential outcome means (ATE) of credit rationing on the net farm income of catfish processors is about 11% and statistically significant at 1 %. The ATE estimate suggests that an average catfish processor's net farm income in the study area will be impaired with about 11% of the net farm income. In the same vein, the conditional treatment effects which measure the ATT of credit rationing on net farm income are about 24% and also statistically significant at 1%. Thus, it suggests that an average catfish processor's net farm income in the study area would be impaired/lower by about 24% of the net farm income than it would if he was not credit constrained. This submission agreed with Dong et al., (2010) and Abdallah et al. (2018), who reported that removal of credt constraint can result in over 23% improvement in farmers' income.

The ex-post estimates of the causal effects of credit rationing on net farm income of catfish processors from the IPWRA are presented in Table 6. The result from the inverse probability weighted regression adjustment estimation indicates that impact of credit rationing on catfish net farm income impairs the net farm income of catfish processors in the study area. From Table 6, the ATT and potential-outcome mean (POM) are approximately 15% and 37% respectively. Thus, the potential impact of credit rationing on the net farm income has a substantial negative impact on catfish net farm income of the processors. Therefore, the impact of credit rationing among catfish processors worsens net farm income and translates to spill-over effects on the welfare of catfish processors in the study area. The negative impact of credit rationing on net farm income of catfish processors agrees with the studies of Ojo et al. (2019) and Ojo and Baiyegunhi (2020) in Nigeria. These findings are also consistent with the studies of Chandio et al. (2017), Elahi et al. (2018) and Amanullah et al. (2019), with views that credit constraints have a negative impact on farmers' income.

[1] ATE and ATT were estimated as a post-estimation after fitting the Stata command movestay for endogenous switching regression. The ATE estimated after movestay is the potential outcome means, while ATT is the conditional treatment effect

Table 5. Treatment effects for the impact of credit rationing on net farm income of catfish processors – endogenous switching regression

Treatment effects	*Coefficient*	*Std.*
Average Treatment Effect (ATE)	-0.113***	0.623
Average Treatment on Treated (ATT)	0.240***	0.388

Table 6. Treatment effects for the impact of credit rationing on catfish net farm income – inverse-probability-weighted regression adjustment

Treatment effects	*Coefficient*	*Std. Err.*
Average Treatment on Treated (ATT)	-0.1457*	0.0749
Potential-Outcome Mean (POM)	-0.3656***	0.0723

Note: The bootstrap replications were changed from 100 – 1,000, but no significant change occurred, hence 500 replications were used to bootstrap the standard errors

Conclusion and Recommendations

The study provides direct evidence of how farmers' socio-economics influence credit rationing. In addition, it investigates whether credit rationing affects net farm income of catfish processing. The results show that catfish processing is a profitable farm venture, but opportunity to expand production is limited by credit rationing. It was also gathered that rationing of credit to processors is influenced by membership of associations, years spent in acquiring formal education, processing experience, frequency of credit request and interest rate. Thus, highly educated catfish processors, who do not belong to farmers' groups/associations, have long processing experience, a low frequency of credit application and are issued high interest rates are more likely to be credit rationed. The results of the endogenous switching regression model further show that credit rationing impacts significantly on the net farm income of processors that are prime-aged, have higher levels of education, long processing experience, sell at a high price and have large processing capacity. However, the role of association membership, formal training, credit history and credit interest in the net farm income of rationed processors are negligible.

The results from this study have potentially important policy implications. Firstly, our results have shown that membership of associations provide opportunities to proactively eliminate credit rationing and boost earnings from catfish processing. Inasmuch as socio-inclusiveness increases both the tendencies to receive full loans and optimizes the use of such loans, forward looking policy from government and interest groups would be to target mechanisms that will encourage development of group borrowing habits among catfish farmers in response to the ongoing farmer-friendly credit policies in Nigeria. Secondly, given the fact that net farm income of prime-aged processors with lower education is more likely to be affected by credit rationing, it would seem prudent for lenders and policy makers to protect the interests of both old and less educated catfish processors with a large processing capacity

in the agricultural loan regulations for financial institutions. Similarly, efforts must also be put in place by the Nigerian government to provide interest rate subsidies on agribusiness loans for young processors, as this category represents a significantly high proportion of credit rationed processors that have higher tendencies to optimize credit use in catfish processing. Thirdly, the results of this study confirm that the informal lending agencies can overcome credit rationing shortcomings and cushion existing financial gaps and inequalities in the Nigerian credit market if informal interest rates are regulated. Therefore, it would seem prudent for policy makers to integrate some of the existing laissez-faire financial agencies into the formal credit marketplace via microfinancing arrangements to offset microeconomic intricacies facing catfish processors in the expansion of the catfish processing industry in Nigeria. In the same vein, adequate credit access can increase farm income of resource-constrained farmers. In the light of the outcomes, this study presents essential suggestions to Nigerian financial institutions (formal and informal) that catfish processors in the studied region are vulnerable to credit rationing. Thus, if the rural credit market improves on credit service delivery to catfish processors, it may facilitate farmers to buy the optimal level of inputs that boosts commercialization benefits.

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