THE IMPACT OF CREDIT ACCESSIBILITY ON AQUACULTURE PRODUCTION IN MEKONG DELTA, VIETNAM

Nguyen Ly[1] and Le Khoa Nguyen[2]
[1]*Department of Economics, Nong Lam University, Ho Chi Minh City*
[2]*School of Advanced Study, Ho Chi Minh City Open University*

(Received: 20/04/2014; Revised: 02/06/2014; Accepted: 28/7/2014)

ABSTRACT

This paper aims to assess the impact of credit access on aquaculture profitability of farmers located in the Mekong Delta, Vietnam. The results imply that farmers with loans had higher profit in comparison to those without loans. In addition, the different status of land ownership in terms of gender influenced farming net revenue. Test for endogeneity of credit participation and income proved that the instrumental variable model was more accurate in comparison to the ordinary least square estimation in estimating factors affecting aquaculture farming profit.

Keywords: *credit access, loan, profit, aquaculture, household, Mekong Delta*

1. Introduction

Vietnam, one of the major aquaculture producers in Asia, is experiencing significant growth in exporting fish and fish products. The value of fish exports increased from US$1.5 billion in 2000 to US$5.1 billion in 2010, making Vietnam the fourth-largest exporter of fish products in the world (FAO, 2012). The fishery industry contributed 3.1 – 3.7% to Vietnam's national gross domestic production during the period 2001-2011, and accounted for 24.44% of the value of the nation's agricultural exports. *Pangasius,* catfish and brackish water shrimp are two major crops of the Vietnam fishery industry, particular in the Mekong Delta. The European Union (EU) and the United States of America (USA) are the main importers of these two products.

Any factors that influences the fishery industry would impact Vietnam's national export earnings because the significant proportion of fishery in total export value (5.1% in 2013 (General Statistics Office of Vietnam, 2014). It is a given that aquaculture is a high-risk industry because of high disease spread, but aquaculture farmers must also deal with a number of other issues that affect their production potential (Quagrainie, Ngugi, and Amisah, 2009). These issues include a nonstable-market price, world market crisis, anti-dumping tax, financial constraints, and limited accessibility to credit. For aquaculture farmers in particular, credit is necessary not only because of limitations of self-finance, but also because of the uncertainty pertaining to the level of output and the time lag between inputs and outputs (Pham and Izumida, 2002). Therefore, capital is one of the factors needed to operate an efficient, viable, and profitable aquaculture enterprise (Quagrainie, Ngugi, and Amisah, 2010). Both current and potential producers of catfish indicate that credit difficulties (financial constraints, limited accessibility to credit, high interest rates, and complicated procedures and requirements) are the primary constraints to operate their business (Bacon et al., 1993). The constraint of finance forces farms to operate below optimal levels, leaving them more vulnerable financially to adverse production and market conditions. Access to credit in aquaculture

farming, however, has been hampered by lenders' perception of the high-risk, high-investment, and low potential returns from the industry (Engle and Kumar, 2011; Pomeroy and Getchis; Miyata and Sawada, 2007).

Although the Vietnamese rural financial market is perceived as fragmented with many credit providers (McCarty, 2001; Pham and Izumida, 2002), the Vietnamese government has initiated priority credit policies to help support aquaculture farmers. Up to now, the government has adopted a number of policies that support aquaculture production. Recent guidelines ask banks to do the following: provide lower interest rate loans for aquaculture farmers, apply the trust loan instead of a collateral loan, and simplify the overall loan procedure. Along with these supports, the local lenders are also encouraged to coordinate closely with and support farmers in buying input materials as lower cost, help them establish an efficient production plan, and contribute to improvement of local infrastructure. This assistance should contribute to a better livelihood for famers and help alleviate poverty rural areas via improving their productivity of faming. Currently, the government is reviewing their financial support policies for aquaculture (Tran, C. T., 2013). The primary intent is to further enhance famer financial capacity by 2014. Some question that whether these supports aquaculture efficient incentive for aquaculture farmers, and whether these policies will provide a positive impact on aquaculture production. Surprisingly, studies related to examining the impact of credit issues on aquacultural production do not exist (Duong and Izumida, 2002). Therefore, the purpose of this paper is to fill that gap by investigating how credit accessibility affects the profitability of aquaculture farmers living in the Mekong Delta, as a case study. Results from this research will be used to determine the impact of government supports on aquaculture production and will help in recommending more accurate supports in the next stage. The paper is organized as follows: (1) The Introduction provides some background information on the aquaculture industry in Vietnam and the significance of this research. (2) The second part is a Literature review that covers previous papers along with the methodologies used to to examine the impacts of credit access on aquaculture production. (3) The Methodology presents information on how instrumental variable (IV) is applied to evaluate responses to the collected data. (4) The Results and Discussion examines the predicted outcomes obtained by analyzing data and information collected from the household living standard survey via IV, and discusses patterns, trends of effects. (5) The final part is the Conclusion which summarizes the important results and the significance of impacts to draw conclusions.

2. Literature review

Access to credit is an important factor in determining the adoption of technological innovation (Feder et al., 1985 and Feder and Umali, 1993), and especially influential on adoption of improved agricultural technologies by smallholder farmers in developing countries (Adesina and Zinnah, 1993; Lowenberg-DeBoer et al., 1994; Doss and Morris, 2001). An increased rate of adoption of a new technology is an important source of productivity gains (Shideed and Mourid, 2005) because it occurs with lower production costs and higher outputs from the same inputs. On the other hand, cash flow constraints can cause fish pond to be understocked, with fewer ponds used, and fingerlings of smaller size. All these affect the optimal management strategy of catfish famers, thus causing the farms to be less profitable or even unprofitable (Engle and Kumar, 2011). In addition, limitations of cash flow can decrease annual net returns of a catfish farm by 18% because multiple-batch stocking strategies are required to meet financial obligations.

To determine the interaction between credit access and agricultural profitability, Foltz (2002) investigated what effects credit access has on agricultural productivity. The author used the inverse Mills ratio from the first stage of the probit model to describe credit rationing in the second stage of the OLS

net revenue function. This approach eliminates the self selection or endogeneity of the credit rationing. The findings suggest that credit rationing has direct effects on farm profits, in which the probability of being credit rationed is explained by household expenditure per month and land title. In addition, previous studies have examined the impact of credit on aquaculture production, in particular, and determined what factors influence a farmer's decision to access credit. Quagrainie, Ngugi, and Amisah (2009) used the binary probit model to investigate the factors that influence the probability of farmers using credit facilities for fish farming in Kenyan. The estimation shows that the location, cultured species, total pond acreage, and per unit labor cost significantly attribute to a farmer's decision to use credit facilities. However, the decision making model in this research conceals how a farmer's loan history, the interest rate for a loan, the household's other business needed loan, and type of lenders (formal, informal) may affect the decision process. Working on the same topic but different location, Wetengere and Kihongo (2012) discuss the constraints in accessing credit facilities for fish farmers in rural Morogoro, Tanzania by using the data from participatory rural appraisal and secondary information. Their results show that a lack of information, unfavorable terms, lack of support services, and illiteracy constrain farmers decision on credit access, and thus directly affects their profitability. Similarly, Abunyuwah and Blay (2013) examined the smallholder farmer's accessibility to formal credit in the Nzema East Municipality, Ghana. Through the logit model, these authors show that the formal credit accessibility of fish farmers is influenced by age, education, income, distance to the financial source, family size, credit awareness, and farming experience. The result of this paper may have limited accuracy because it does not mention if the sensored issues may have impacted choices with the logit model.

In Vietnam, Phan et al. (2013) investigated the factors that influenced fish farmers' accessibility to informal and formal credit in 928 households in the Mekong Delta. The authors suggested that land holding status, loan purposes, interest rates, loan duration, direct road access to the village, local government employee, membership in a credit group, poor certificate all had significant on explaining credit accessibility. Moreover, through data collected from a household survey in three provinces of Vietnam, Pham and Izumida (2002) examined the impact of credit on household production. He applied the two-stage estimation to estimate the effect of credit access on a household's total production value. According to the tobit model total farming area and total value of livestock are the determinants of loan accessibility from formal financial institutions. Dependency ration of households and total farming area are factors causing a household to borrow from informal credit sources. In addition, the results also indicate that credit access is highly correlated to household production value.

Overall, this literature review covers research that investigates the effects of credit access on agricultural production, particularly on aquaculture output. The review indicates that there is correlation between credit accessibility and profitability. Related to methods, most authors applied the logit or probit model to estimate which factors influenced the credit access and some of them went a further step by implementing a two-stage model to figure out the effect of credit on productivity. However, no research considered how credit access affected aquaculture profit in the developing countries, but this is where aquaculture accounts for more than 80% of the world's total production. Additionally, no author has used the instrumental variable model to eliminate the endogeneity of farmer choice to participate in the credit market and other possible endogenous variables in the model. Moreover, none of them have mentioned the role of gender in credit access nor do they examine whether gender causes a difference in profit among agricultural households. Therefore, this paper aims to fill in these gaps.

3. Methodology and data

Profit function, in general, is derived

from the difference between the total value product and total cost functions. It represents a maximum profit that an agent can obtain given factor market and goods market conditions. The profit function can be used as a tool to make production selection or decision support subject to production factors, prices, and output quantity. In agriculture area, however, the net revenue function or pseudo-profit function[1] is usually used to estimate the farm profit (Carter, 1989; Foltz, 2004) in order to account for potential imperfect markets of land, labor, and capital. The net revenues differ from economic profits since they do not account for depreciation coasts and payments to fixed cost factors such as land, family labor, and management (Foltx, 2004).

In this paper, the pseudo-profit function is estimated as:

$$\pi_i = \beta_0 + \beta_1 CreP_i + \beta_2 income + \beta_3 educ + \beta_4 farmsize + \beta_5 gender + \beta_6 incost + \beta_7 outprice + \varepsilon$$

Where;

- π_I is pseudo-profit from aquaculture (total revenue – total cost)
- CreP: 1: household with loan; 0: household without loan
- Income: household income excluding income from aquaculture
- Educ: education level of household head
- Farmzise: size of aquaculture farm (ha)
- Gender: gender of land owner in household (man:1; women: 2; both: 3)
- Incost: unit cost of labor and land rent
- Outprice: average price of aquaculture products
- ε is random error term caused by unobservable variables in the model

The error term, represents both of the unobservable latent qualities of farmers and lenders, as well as potential noise in the data, is assumed to be normally distributed with mean zero and variance equal to one. The credit access variable represents observable farm and farmer characteristics including total farm area, total value of property, famer's education, famer's experience. For instance, one would expect that larger total farm area would increase the probability of being credit access as well as the farm profit because of the economy of scale. As result, this variable is expected to affect the household income. If we cannot control for these observable characteristics, the attributed error term in this model will be correlated with the error term from credit access and household income equation. In other words, credit status and income are endogenously determined in a way that may be systematically related to expected credit effects. This systematic relationship between credit access/income and the latent variables component of the pseudo-profits error structure creates the consistency problem for OLS estimation. In this case, the two instrumental variables (credit access and income) are applied to switch the endogenous regression. On the other hand, the instrumental variable can fix omitted variable bias from a variable that is correlated with other explanatory variables but are unobserved so cannot be included in the regression, simultaneous causality bias, and errors-in-variables bias of explanatory variables.

Related to the credit access, the paper uses the probit model instead of logit model to eliminate error in case the choices are not completely different. The probit model to estimate factors affecting the farmer's choice to loan or not to loan for their fish farming operation specifying the conditional probability as

$$p = (\int_{\downarrow}(-\infty)^{\intercal}(x^{\intercal\prime}\beta)\,[\phi(z)dz] = ((x^{\intercal\prime}\beta)$$

Where p is a binary variable which indicates whether farmer accessed the local credit or not and x is a vector of explanatory variable including the variables mentioned in the second-stage model and instrumental

[1] Carter (1989) named "pseudo-profit" to distinguish the net-revenue function from conventional profit function

variable. The variables are expected to influence the credit access without effect the farming net revenue are value of household's owned property (property), local union member (unimem), poor certificate[2] (poorcer), interest rate (interest), loan duration (time), credit history (loanhis).

On the other hand, there is potential for the joint distribution of household annual income and loan demand because the measurement errors of loan access are likely to be correlated with measurement errors in income. Therefore, we use the instrument the income, which is explained by Y_k, including living location (location: urban or rural area), major occupation classification (job), number of people working outside of the farm/HH (labor), number of working people/HH, and income from out of aquaculture production (income).

$$income_i = \delta_0 + \delta_k X_k + \delta_k Y_k$$

Test for validity of instrumental variables

The valid instrumental variable is expected to have (1) uncorrelated with the error term, (2) correlated, and (3) strongly correlated with the regressors in the second-stage model. In addition, the number of instruments must at least equal the number of independent endogenous component. If an instrument fails the one of above conditions the instrument is an invalid instrument, irrelevant instrument, unidentified, or weak instrument. In practice, it is not obvious that the regressors in the model are correlated with the disturbances or that the regressors are measured with error. Therefore, in order to have a valid instrument, the paper applies Hausman test to see if the estimation between OLS and IV are different via auxiliary regression. If they differ significantly, we conclude that there is endogeneity in the model. Moreover, the test for over - identification restrictions, goodness-of-fit measure to show that whether the estimated model fits the data quite well as reflected by the indicator of percentage correct predictions.

Data

Paper uses the data from the Vietnam Household Living Standard Survey (VHLSS) in 2012 provided by the General Statistic Office (GSO). From 2002 to 2012, this survey has been conducted regularly by the GSO every two years in order to evaluate living standards for policy-making and socio-economic development planning. The VHLSS 2012 was conducted nationwide with a sample size of 9,399 households in 3,133 communes/wards (63 provinces) who representative at national, regional, urban, rural, and provinces levels. The survey collected information during four periods, each period in on one quarter in 2012 and one period in the first quarter of 2013 through face-to-face interviews and respondents are household heads. The paper applies the data of aquaculture households living in the Mekong Delta (13 provinces), a subsample 923 households. These households are chosen since they are living in the Mekong Delta, producing aquaculture, having availability of sufficiently detailed information on costs and benefits of this production. The data also provides information on household characteristics, access to amenities, and market orientation.

4. Results

Data description

There are 22 variables used in this model including the instruments. The average price of aquaculture products equals to total value of aquaculture divide total harvested quantity. It shows the variety of selling price by household from VND[3] 1 – 350 thousand. It may be caused by the location, the quality of product, and the fish species such as shrimp or catfish because this is the average price of all aquaculture products. Profit is the difference between total revenue and total cost of

[2] In Vietnam, a household with total income equal or less than of US $20/month in rural area and US $25/month in urban area receives a poor certificate that provide them priority in accessing the food supply, low-interest loan, low-cost materials, and other social supports.

[3] The exchange rate of Vietnam dong and the USA dollar currently is 21,800

aquaculture production ranging from negative to positive values, in which 321 households (28%) have the negative profit in 2012. The proportion of household having negative profit is relatively high because the general effect from the world economic crisis that affects the export price, high growth rate of input price, and climate change impact. Average age of household head is 34 year old, the oldest is 92 and the youngest is 20. The data also shows that the share of population aged 20-50 year old in rural areas is higher than in urban areas because most of aquaculture farmer located in rural areas and the number of women in this population is higher than man. It presents the reality case in Vietnam as well as in some Southeast Asia countries since the ratio of women to men in rural areas is higher than in urban areas because most men in rural areas moves to urban areas to look for a non-farm jobs with expectation of higher income and more opportunities for earning money in urban area. However, because of their owned farms, houses, and their parents, they let their wives stay at home to take care the farm and their families.

Major occupation structure of household shows whether the household head works on farms or outside of the agricultural, forestry and fishery sectors. Obviously, the poor households mainly remain in purely agricultural jobs with low income because they are less likely to attend school, and often have to go to work to earn a living early in their life (15-16 year old). Whereas, the richer the households, the household heads are more likely to work in non-farm sectors with higher income. The share of people who have no diploma or illiterate of respondents was 22% , females has 1.6 times higher than males. These numbers will be used to explain whether there difference in production efficiency between men and women as household head. Related to income, in 2012, the annually average income per capita was approximately VND 16 million. In which there are 2% of household had no income as reported. The income gap among regions and household are remained and most income was raised from salary, agricultural, forestry, fishery sectors, and agricultural services.

Regarding to the credit access, most aquacultural farmers (82%) had a loan money from different micro-financial sources. They accessed credit through the local banks, in which the Vietnam Bank for Social Policies is the main credit source (accounts more than 80% of loaned households). In addition, the loan period given for farmers ranges from 0.5 – 4 years, and average is 1.5-year period. This loaning time can support the farmers have long time enough to invest in their farm, especially for the catfish and shrimp cultures, the cycle is normally from four to 12 months. However, the long-period loan would have effect on the repayment rate or default but there is no public report on these issues. Average interest rate the fish farmers paid in 2012 is 8.5% per year, comparing to the interest rate of overall market in Vietnam in the same year (13%), the farmers had accessed to the lower interest rate funds even though this rate is relatively higher than other neighbor countries.

Land for production, share of households having permanent use certificate (owned) was 49%, rent land accounted 31%, and the last is other land owners such as unidentified owner right and public farming area[4]. The average cost of land rent was VND 4.6 million ranging from VND 35 thousand to VND 149 million per season depending on how long and how large of land was rent. In case the land owner, 62% of them are males (husband in a family named on the land owner certificate), 20% of them are males (wife is named on the land owner certificate), and the last is both husband and wife are name of the land owner certificate. In general, whom name printed in the certificate implied they are the owner. As a

[4] Located along Mekong Delta river, most provinces in Mekong Delta, Vietnam access the public water source of this river for their aquaculture production. Property rights system on water sources in this river is diverse. Water can be a private good, a common good, as well as public good, depending on season and location.

result, the whether the owner is husband, wife, or both will affect their way to explore the land as well as their behavior to maintain the land.

Comparing the household and farm characteristics of borrowers and non-borrowers shows that age of household head, major occupation of household head, number of people working outside of the farm, loan sources, member of social support organizations, educational level of household head, landowner title, and gender of landowner are not significantly different between households that obtain loans and households without loans (table 2). However, both revenue and cost to farmers with loans is relatively higher than that of non-borrowers. This implies that the farmers with higher investment or larger production need a loan for their investment or loan support to invest more on aquaculture production. As a result, the income of borrowers is higher than non-borrowers by approximately 35%. Total value of the property of borrowers is significantly higher than that of non-borrowers. With higher property value, household can access a loan easier than those with low property value because of the collateral condition. The household with no ownership certificate can seldom access a loan, because most borrowers will not loan funds to non-certificated household. Therefore, the loan history of the non-borrowers has been less than that of borrowers. Obviously, the non-borrowers have higher costs than borrowers because they paid land rent while borrower did not since they owned the land. Finally, the labor cost (laborcot) for aquaculture production of households with loans is relative lower than that of households without loans. The households with loans may have higher efficiency in investment than households that did not borrow money.

Empirical estimations

Because the values of profit, loan amount, household annual income, farm size, payment for land rent, and labor cost are relatively large, they have been transferred to logarit values to diminish the estimation error that causes heteroskedasticity in the model. As a result, the meaning of these variables in the model is changed into elasticity.

The regression result shows large differences between LS and IV estimates in term of standard error and statistical value, and this is interpreted as evidence of endogeneity. Therefore, the IV in this case will provide the more accurate estimation. The comparison of both models is presented in table 3. In general, the coefficients in the IV are relatively lower than the coefficients in the LS model. However, the standard errors in IV model are relatively higher than those in the LS model. This implies that there is an efficiency loss in IV estimation as compared to LS estimation. Test for endogeneity (likelihood ratio test of H0:_Sigma =0 and _Rho=0) and overidentification shows that the valid instruments for loan participation are own property value, poor certificate, interest rate, and credit history. In addition, the instruments for income are number of people working outside of the farms and total income from other than aquaculture production.

Results from the IV model reflects the positive impact that credit access has on aquaculture production profit. In other words, at the 5% level of statistical significance, households with access to credit had 15% higher profits than households without loan access. The reason is that access to credit is likely to increase the investment on aquaculture farms, increase efficiency of aquaculture farmers, and enhance the adoption of new technologies that attribute to higher net revenue. Credit supply allows farmers to purchase more inputs, which in turn increases revenues and profit (Hyuha et al., 2007). Access to financial markets facilitated the adoption of new production techniques and input materials such as fingerlings, feeds, and environmental treatments. The statistical data also show that households with more funds invested more in their farm operations and expanded the farming area so that they earned more benefit from economies of scale.

However, the more investment the farmers made, the higher risk they had to deal with in case of disease spread. In reality,

disease spread occurred at high rates during previous years and caused many farmers to be without house and land because they lost everything when banks took their property as collateral. The greater the investment in fish farming, the larger the number of individual farms that exceed environmental standards. In the past, intensive fish farming has been associated with waste streams that often exceed water quality standards. Therefore, it is necessary to invest in environmental treatment, disease control, and improve a household's awareness of the environment issues that arise with their expanding production.

The coefficient of educational level was positive and statistically significant at 1%. This implies that the household with higher education could earn higher net revenue from their farms. On the other hand, education can enhance the acquisition and utilization of information on improved technology by farmers as well as improved their entrepreneurship. These improvements would contribute to increase efficiency of farming. The rent payment variable is expected to have a negative effect on production because it increases costs. However, in this case, households that paid more for land rent had higher benefit. In the Mekong Delta, almost all households in the pond culture owned a pond and only a small proportion of those households engaged in fish trading and fingerling trading rented their pond. In the period 2009-2012, the export price of catfish and shrimp increased significantly, and farmers who earned high benefit from farming had to rent as much land as they could to culture catfish and shrimp at high cost. As a result, the poor or less efficient farmers did rent their land out to others with higher productivity. This explains how famers with higher payment for rent could get a higher benefit. It is understandable that when fish prices increase, a household earns more profit immediately. This variable is statistically significant at the 1% level, implying that when average fish price goes up 1%, the total benefit to a farmer increases by 17%. The owner status of land also affects a farmer's benefit in a similar manner, since this factor contributes to reduced cost of production. Famers with their own land should have a lower cost as compared to the farming-land rent situation. The results here show that the owned-land farming system increases total benefit by 32% in comparison to rented-land farming.

Moreover, the gender in land-owner farming also affects net farm revenue. In particular, at the 5% level of statistical significance, the land owned by men had a 13% higher profit than land owned by women. This relatively high effect indicates that there is a difference in land management and use between men and women that affects productivity. Traditionally, the owner of land is supposed to spend more time on their farm, hence, male or female ownership impacts farming productivity. In general, land is transferred from parents to their son with expectation that the son can farm better than their daughter. This does make sense, because Vietnam is no different than other developing countries where women spend most of their time taking care of children and household work. Therefore, they have little time for farm work, so most of them hire others to do the farming or lease their farm and this result in lower efficiency. In addition, aquaculture farming is seen as hard work and men are better suited for the task than women.

5. Conclusion

Estimation of the pseudo-profit function indicates the effect of credit access on total net revenue of aquaculture farmers in the Mekong Delta. The result shows that the profit of borrowers was 15% higher than that of non-borrowers. This implies that better access to the credit market will improve the profitability of fish farmers. Though the interest rate has been recently dropped for the aquaculture industry, access to credit is still a challenge for farmers because of collateral requirement. As a result, most of the households that rent and do not hold ownership certificates could not access credit sources. Estimation from the instrumental variable model implies that ownship property value, poor certificate, interest rate, and credit history are valid terms for explaining the participation instrument.

Although the poor certificate aims to support the poor farmers, most of them receive no financial access because of low-valued property that prevents them from having adequate collateral. This result is consistent with the paper done by Foltz (2002), Vuong (2012), and Pham and Izumida (2002).

On the other hand, the discrimination of gender in land ownership had an effect on farming net revenue. The households with land owned by women were less profit less profitable than land owned by men by13%. In addition, profitability of aquaculture farming was also influenced by education level of the household head, average fish price, land owner status, and total payment for land rent.

This result proves the efficiency of Vietnamese government programs to support the fish farmers in the Mekong Delta. However, because of aquaculture being a high-risk industry and a collateral requirement for loan, the poor households were not really benefited from this program and the benefit gains were highly dependent on environmental conditions. Therefore, the intervention from government for better environmental pollution treatments, disease control, and collateral elimination is needed, especially for the poor fish farmer if he is to have access to the funds needed to expand production.

Appendix

Table 1. Statistical Description of Variables

Variable	N	Mean	Std Dev	Minimum	Maximum
Price	923	48.0	50.3	1.0	349.4
revenue	923	30,695.8	345,011.4	10.0	10,042,027.0
Cost	923	25,498.3	344,636.4	5.0	9,366,825.0
Age	923	33.6	20.7	-	92.0
Job	923	2.8	1.6	1.0	9.0
location	923	1.5	0.5	1.0	2.0
labor	923	2.7	1.5	1.0	7.0
Income	923	15,868.6	32,574.1	-	320,494.0
property	923	2,289.2	4,284.2	20.0	40,000.0
loanso	923	1.3	1.0	1.0	5.0
loan	923	16,480.3	13,246.8	-	200,000.0
interest	923	0.8	1.4	-	17.0
time	923	1.7	1.2	0.5	4.0
Poorcer	923	1.9	0.3	1.0	2.0
Unimem	923	1.9	0.3	1.0	2.0
loanhis	923	1.9	0.4	1.0	3.0

Variable	N	Mean	Std Dev	Minimum	Maximum
Edu	923	3.6	1.2	-	5.0
land	923	5,542.1	14,519.0	25.0	244,566.0
rent	923	4,645.7	11,374.6	35.0	149,500.0
landown	923	1.1	0.4	1.0	7.0
gender	923	0.6	0.2	-	1.0
laborcot	923	4,074.6	2,876.0	268.0	32,240.0
Profit	923	6,266.9	505,872.2	(9,345,892.0)	10,018,322.0

Table 2. Household and Farm Characteristics of Borrowers and Non-Borrowers

Variable	Without loan	With loan	T-test
Price	33.4	48.8	2.18**
revenue	15,383.8	31,535.7	5.16***
Cost	4,524.1	26.779.6	5.82***
Age	37.3	33.4	1.29
Job	2.5	2.8	1.00
location	1.4	1.5	0.78
labor	3.0	2.7	1.20
Income	15,586.4	21,011.9	2.89**
property	1,271.7	2,345.0	3.39***
loanso	1.3	1.3	0.01
Poorcer	1.2	1.9	2.48**
Unimem	2.0	1.9	1.10
loanhis	0.7	1.9	4.85***
Edu	3.8	3.6	1.76
land	5,131.9	5,564.6	1.93*
rent	5,057.2	4,619.1	2.01**
landown	1.2	1.1	0.87
gender	0.3	0.4	0.75
laborcot	3,355.3	4,114.0	2.83**

*Note: *** significant at 1%, ** significant at 5%, * significant at 10%*

Table 3. Estimation Results from OLS and IV Models

Variable	OLS		IV	
	Coefficients	Standard error	Coefficients	Standard error
CreP	0.23	0.06***	0.15	0.08**
Lnincome	-0.03	0.01*	0.02	0.16
Edu	0.07	0.02**	0.03	0.01*
Farmsize	0.09	0.06	-0.09	0.07
Lnrent	0.07	0.01***	0.19	0.07***
Gender	0.38	0.03***	0.13	0.02**
Lnlab	-0.28	0.14*	0.22	0.19
Price	0.02	0.00***	0.17	0.00***
Landown	0.40	0.16**	0.32	0.11**
Constant	10.67	1.90***	9.65	2.84**
F-statistic	5.73		5.47	
Observations	923		923	

*Note: *** significant at 1%, ** significant at 5%, * significant at 10%*

REFERENCES

Abunyuwah, I. and J. K. Blay. (2013). "Accessibility Constraints of Small-Scale Fish Farmers to Formal Credit in the Nzema East Municipality". *Journal of Economics and Sustainable Development*. 4(1).

Adesina, A and M. Zinnah. (1993). "Technology Characteristics, Farmers' Perceptions and Adoption Decisions a Tobit Model Application in Sierra Leone". *Agric Econ* 9:297–311.

Bacon, J.R., W. Lussier, B. Dowse, and C.M. Gempesaw II. (1993). "The Potential for Aquaculture in Delaware and Maryland: A Survey of Current and Potential Aquaculture Producer. University of Delaware". *Agricultural Experiment Station Bulletin* #500, Dover, Delaware.

Carter, M.R. (1989). "The Impact of Credit on Peasant Productivity and Differentiation in Nicaragua". *J. Develop. Econ*. 31:13-36.

Carole, R. E. and L. Gayle. (1994). "Pounds Trade-Offs Between Single and Multiple-Batch Production of Channel Catfish, Ictalurus Punctatus". *Journal of Applied Aquaculture*. 3:311-332.

Doss, C.R. and M.L. Morris. (2001). How Does Gender Affect the Adoption of Agricultural Innovations? The Case of Improved Maize Technology in Ghana. *Agric Econ* 25:27–39.

Engle, C.R. and G. Kumar. (2011). "The effect of Cash Flow and Credit Constraints on Financial Feasibility and Stocking Strategies on U.S. Catfish Farms: a Mixed-Integer Multi-Stage Programming Approach". *Aquaculture Economics and Management*. 15(3):70-91.

Feder, G. and D.L. Umali.(1993). The Adoption of Agricultural Innovations: A review, Technological Forecasting and Social Change, 43(3–4),215-239.

Feder, G., R.E. Just, and D. Zilberman. (1985). Adoption of Agricultural Innovations in Developing Countries: A Survey. *Econ Dev Cult Change* 33:255–298.

Foltz, J. D. (2004). "Credit Market Access and Profitability in Tunisian Agriculture". *Journal of Agricultural Economics*.30:229–240.

Hyuha, T.S., B. Bashaasha, E. Nkonya, and D. Kraybill. (2007). "Analysis of Profit Inefficiency In Rice Production in Eastern And Northern Uganda". *African Crop Science Journal* 15(4): 243-253.

Lowenberg-DeBoer, J., T. Abdoulaye, D. Kabore. (1994). The Opportunity Cost of Capital for Agriculture in the Sahel: Case Study Evidence from Niger and Burkina Faso. Staff Paper. Department of agricultural Economics, Purdue University, West Lafayette.

McCarty, A. (2001). Microfinance in Vietnam - A Survey of Schemes and Issues. Hanoi, Vietnam. Department of International Development (DFID) and the State Bank of Vietnam (SBVN)

Miyata and Sawada. (2007). *Learning, Risk, and Credit in Households' New Technology Investments*: *The Case of Aquaculture in Rural Indonesia*. http://www.cid.harvard.edu/neudc07/docs/neudc07_poster_miyata.pdf

Phan, D. K., C. Gan, G. V. Nartea, and D. V. Cohen. (2013). "Formal and Informal Rural Credit in the Mekong River Delta of Vietnam: Interaction and Accessibility". *Journal of Asian Economics*. 26:1-13

Pomeroy, R. and T. S. Getchis. Financing the Aquaculture Operation. *Sea Grant Connecticut*. http://seagrant.uconn.edu/publications/aquaculture/

Shideed, K. H. and M. E. Mohammed. (2005). Adoption and Impact Assessment of Improved Technologies in Crop and Livestock Production Systems in the WANA Region. The Development of Integrated Crop/Livestock Production in Low Rainfall Areas of Mashreq and Maghreb Regions (Mashreq/Maghreb Project). ICARDA, Aleppo, Syria, viii + 160 pp. En.http://impact.cgiar.org/pdf/297.pdf

Tran, C. T. (2013). Overview of Agricultural Policies in Vietnam. FFTC Agricultural Policy Database.

Wetengere, K. and V. Kihongo. (2012). "Constraints in Accessing Credit Facilities for Rural Areas: the Case of Fish Farmers in Rural Morogoro, Tanzania". *Journal of Applied Aquaculture*. 24: 107-117.