Research on the Demand and Availability of Formal Loan in Aquaculture—Taking the Flatfish Farmers as an Example

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***Abstract*—Based on the survey data from Shandong and Liaoning Province, this paper investigates the factors that influencing the formal loan demand and availability of aquaculture farmers in China. The results show that: (1) Culture area and technical level have the positive impacts on the formal loan demand. (2)Technical level and the number of bank visit for loans can have the positive impact on the formal loan availability. But the scale of loans and the distance to financial institutions have a negative impact on the formal loan availability. In addition, Liaoning Province loan availability is significantly higher than that in Shandong Province. (3) Culture area and technical level have positive influence on both applied and approved loan amounts. (4) The applied and approved loan amounts for factory culture are both significantly higher than those of pond culture.**

***Index Terms*—formal loan demand; formal loan availability; aquaculture farmers**

I. Introduction

As an important part of China's agriculture, fisheries play an important role in providing animal protein, raising the income of fishermen and ensuring food security. Since the reform and opening, China has carried out the policy of "aquaculture primarily" to accelerate the development of aquaculture. Since 1989, China's aquaculture production has been ranked first in the world. In 2015, China's aquaculture production accounted for 73.70% of China's aquatic products and 61.62% of the total world aquaculture. Aquaculture has become the main driving force of aquatic products growth. Flatfish aquaculture industry, as an important industry of aquaculture, had annual output of 149.5 thousand tons in 2015, slightly lower than yellow croaker aquaculture by 5.5%. Flatfish aquaculture's factorization and investment threshold were higher than the conventional fish aquaculture [1]. Therefore, flatfish research will be a very important reference to the development of aquaculture in China.

The aquaculture industry in China has its own characteristics such as high risk, long cycle financing, industry special seasonal characteristics and etc. Besides, it requires a large amount of fixed assets investment and business start-up capital during the process of breeding, and aquaculture farmers mostly located in rural areas have certain similarity between farmers and small and medium sized enterprises. All those attributes have led to the lack of financing support from formal financial institutions in the aquaculture industry. The shortage of fund supply cannot meet the needs, especially to those private aquaculture farmers who are even more difficult to obtain the necessary loans from formal financial institutions.

Fishery finance is an important part of agricultural finance. As there are some similarities of loan behavior between aquaculture farmers and ordinary farmers, it is necessary to analyze the behavior of aquaculture farmers' loan behavior research. Most of the research on the behavior of rural households' borrowing and lending is mainly from the rural households' borrowing demand and availability [2].

From the perspective of the rural household loan demand, first of all, current research has not drawn definite conclusions on whether there is a demand for loans. Ma Xiaoqing *et al*. (2012) pointed out that the majority of farmers are in the short-term demand for small loans [3]. But Li Qinghai *et al*. (2016) research showed that most of the farmers' credit needs are met; however the main problem is that loan demands of farmers is low [4]. At present, many researchers start with the analysis of the farmer individual characteristics, management characteristics, social relations, financial environment and others. Liu Xichuan *et al*. (2014) pointed out that the interest rate is an influence factor affecting loan behavior of farmers from the formal financial institutions [5]. Those literatures show that different regions and industries have different influencing factors of farmers' loan demand.

From the perspective of the rural household loan availability, Yi Xiaolan (2012) uses Tobit model to find out the household productive fixed assets, asset size and household income can influence on the loan availability of farmers [6]. Xu Zhangyong and Yang He (2014) adopt the probit model with dual variables to find out that social capital is helpful to improve the loan availability and loan scale [7]. Liu Huihuang and Wu Wei (2015) pointed out that the farmer's identity and the risk preference significantly improve the availability, while

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asset size and household income significantly affect the amount of loan [8].

From the perspective of loan behavior of aquaculture farmers, Tan Yanliang *et al*. (2012) pointed out that the fishery is a weak basic industry with public goods attribute. Government intervention in the market of fishery financing elevated the access threshold for financial institutions. Thus the financial institutions monopoly leads interest rates of fisheries loan to become too high, reducing the aquaculture farmers' loan demand [9]. The aquaculture industry is mainly based on the household contract management, so there is a lack of collateral and security. But the development of modern fishery elements need advanced aquaculture facilities, feed and management. Along with such growth of fishery, culturists are increasing the loan scale from the formal financial institutions (Zheng Shizhong and Sun Jianfu, 2012) [10].

From the existing research in the study of the demand and availability of formal loans, the scholars mainly aimed at farmers and lacks research on aquaculture farmers. The special characteristics of fishery industry make its financing demand quite different from other industries in agriculture, so it is necessary to further analyze the behavior of farmers. Secondly, the majority research uses the existence of the demand for loans to indicate the availability of farmers' loans. However in fact, the proportion of amount of loans approved versus the amount applied is quite different between different farmers. Therefore, taken flatfish farmers in Shandong Province and Liaoning Province as an example, this paper explores the aquaculture formal loan demand and availability, aiming to help promote the sustainable development of fishery modernization in China.

II. Data Source and Variable Definition

A. Data Source

The data used in this study is flatfish aquaculture farmers' survey database from Shandong and Liaoning Province, Which conducted by industrial economic researchers of National Technology System for Flatfish Culture Industry from July to August in 2014. As the flatfish production in Shandong and Liaoning Province accounts for 80% of the national total, the selection of two provinces is more representative. The survey consists of 175 samples. The final effective samples are 141 and the effective rate is 80.57% after excluding 34 samples which are either medium or large size enterprises over RMB 500 million sales or invalid samples with incomplete information [1]. The data is shown in Table I and Fig. 1:

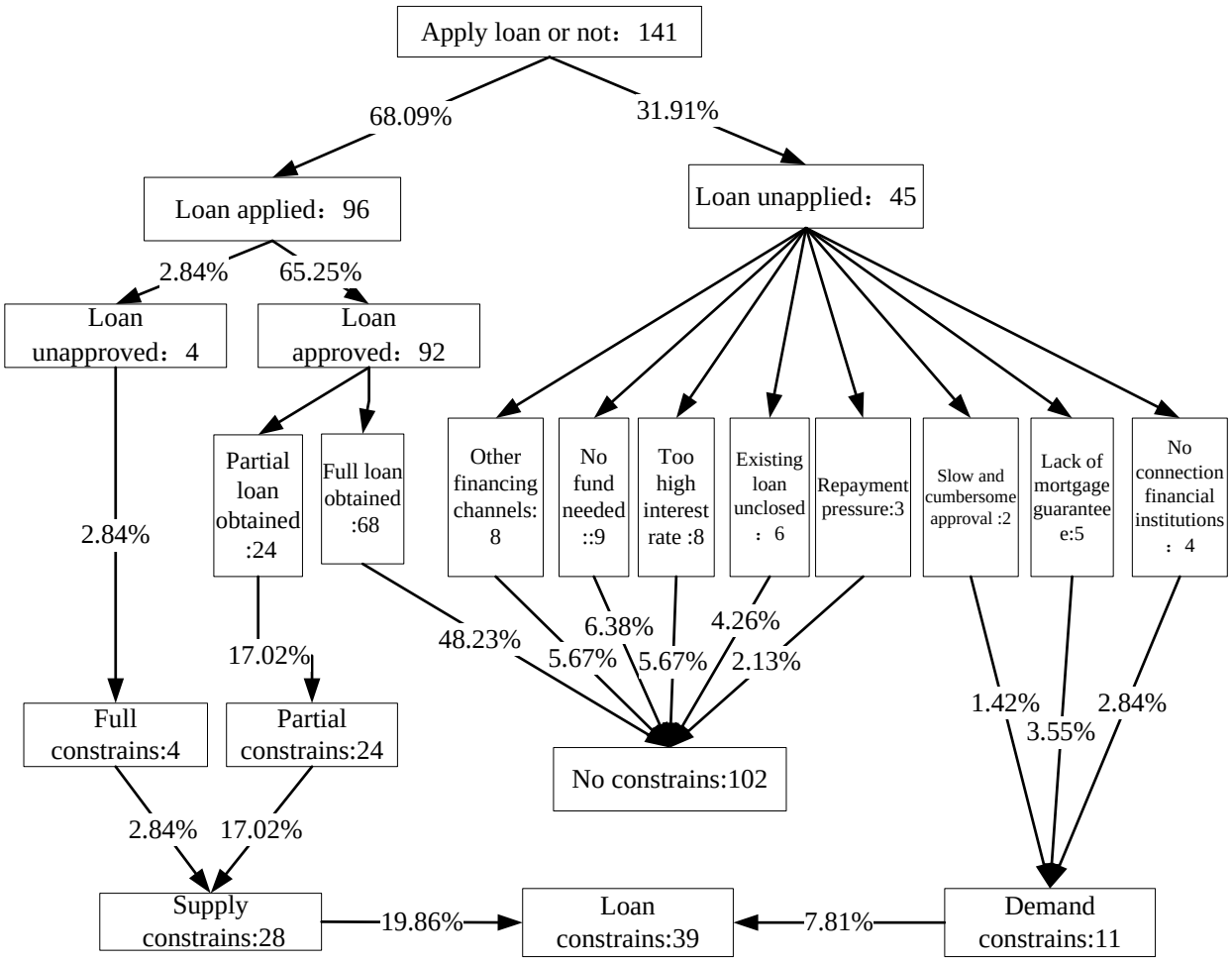

Figure 1. Identification of sample farmers' loan constraints and loan demand

TABLE I . SAMPLE DISTRIBUTION

Location	Liaoning Province			Shandong Province	
	Xingcheng County	Suizhong County	Donggang County	Laizhou City	Binhai New Area
Number of sample	31	29	31	32	18

In the survey of aquaculture farmers, there are 45 samples which did not apply for loans, accounting for 31.91% of the total sample. The reasons for those samples include “slow and cumbersome approval” in 2 samples, “lack of mortgage guarantee” in 5 samples and “no connection in financial institutions” in 4 samples, accounting for 24.44% of the samples that did not apply. All above samples belong to credit constraints as they have potential formal credit demands. Others reasons instead include “existing loan unclosed” in 6 samples, “too high interest rate” in 8 samples, “no fund needed” in 9 samples and “other financing channels” in 8 samples, accounting for 75.56% of the sample that did not apply. Obviously, these samples do not have loan constraints. The survey shows the loan constrains due to the breeders themselves accounts for only 7.81% of the total sample.

Most of the previous studies believe that the aquaculture industry has serious loan constraints. Because the formal financial institutions have the incentive to reduce financial risk and then refuse to provide loans to farmers or less loan amount, the degree of loan availability is not high. However, it is difficult to support the above results using this research data. The data show that the loan supply constraints caused by formal financial institutions only account for 19.86% of all samples. Based on this, it is necessary to further analyze the factors that influence the applicant's application for formal financial institutions and the factors affecting the availability of formal loan.

B. Variable Definition

Dependent variable include: (1) P in Table II denotes “formal loan demand” from aquaculture farmers. If loan has been applied, the formal loan demand is 1, otherwise 0. (2)Y in Table II denotes “formal loan availability” to aquaculture farmers. In order to make a detailed analysis of the formal loan behavior of farmers, first consider the factors influencing the loan amount applied (App) and final approved to aquaculture farmers (Get). And then calculate the formal loan availability by using the ratio between the amounts of loan approved versus loan applied from formal financial institution.

According to the existing research, the factors that influence the normal aquaculture farmers’ loan demand consist of four aspects such as farmer’s endowment, operating characteristics, technology level and loan transaction cost. Overall, the total of 12 variables is shown in Table III.

TABLE II . DEPENDENT VARIABLES AND DESCRIPTION

Influence Factor	Variables	Symbol	Description of Variables
Formal Loan Demand	Whether loan has been applied	P	Loan applied=1，Loan unapplied=0
Formal Loan Availability	Applied amount	App	Amount of loan applied
	Approved amount	Get	Amount of loan approved
	Loan availability ratio	Y	Amount of loan approved/Amount of loan applied

TABLE III . INDEPENDENT VARIABLES AND DESCRIPTION

Influence Factor	Variables	Symbol	Description of Variables
Farmers’ Endowment	Farmer’ age	Age	Age(year)
	Working years	Time	Years of conducting aquaculture (Year)
	Location	Area	Liaoning Province=1，Shandong Province=0
Operating Characteristics	Culture area	Size	Less than 1000 m2 of culture area=1, More than 3000 m2 =3, between 1000 and 3000 m2 =2
	Operating income	Incom	Operating income
	Production expenditure	Expen	Production expenditure
Technology	Culture model	Bway	Factory=1，Pond=0
	Culture technology	Link	Frequent contact with the comprehensive test station (or technician)=1，Otherwise=0
Loan Transaction Cost	Distance to financial institution	Dist	The distance between farmer household and the nearest financial institution.
	Number of bank visits	Freq	Number of visit times to obtain loan from financial institutions
	Social resource	Rela	Whether there is social resource，Yes=1，No=0

C. Descriptive Statistics

Table IV is the descriptive statistics of dependent variables. From Table IV, the average loan amount of applied is CNY 397,000 and the average loan amount of approved is CNY 321,300. The difference between the above both numbers constitutes to loan demand gap, which is CNY 85,800. The ratio of the gap can be calculated as （39.71-31.13）/39.71=21.61%. From data, it can be known that compared with conventional fish aquaculture or agricultural industry, flatfish aquaculture industry has larger demand for funds so that small farmer loan has been unable to effectively meet the industry demand. It is also worth noting that flatfish culturists' loan availability ratio is 84.4%, suggesting that the proportion of obtaining formal financial institutions support is relatively higher to flatfish.

TABLE IV . DESCRIPTIVE STATISTICS OF DEPENDENT VARIABLES

Variables	Culture Model	N	Mean	Median	SD
Application Probability	All	141	0.681	1	0.468
	Pond	37	0.730	1	0.450
	Factory	104	0.663	1	0.475
Approved Amount	All	96	31.125	30	20.157
	Pond	27	22.037	20	7.367
	Factory	69	34.681	30	22.389
Applied Amount	All	96	39.708	30	24.884
	Pond	27	30.074	25	16.955
	Factory	69	43.478	40	26.531
Loan Availability	All	96	0.844	1	0.275
	Pond	27	0.838	1	0.247
	Factory	69	0.846	1	0.287

TABLE V . DESCRIPTIVE STATISTICS OF INDEPENDENT VARIABLES

	All Samples		Samples of loan applied		Samples of loan unapplied	
	Mean	SD	Mean	SD	Mean	SD
Age	47.433	5.855	47.135	5.643	48.067	6.301
Time	7.674	4.015	7.563	4.073	7.911	3.924
Area	0.645	0.480	0.677	0.470	0.578	0.499
Size	2.213	0.800	2.281	0.764	2.067	0.863
Incm	84.174	97.157	90.888	107.081	69.851	70.494
Expen	81.502	92.240	88.339	102.698	66.919	63.094
Byway	0.738	0.442	0.719	0.452	0.778	0.42
Link	0.604	0.491	0.682	0.471	0.568	0.498
Dist	15.340	7.653	15.427	8.294	15.156	6.146
Freq	3.780	1.972	3.594	1.833	4.178	2.208
Rela	0.156	0.364	0.156	0.365	0.156	0.367

Table V shows the descriptive statistics of independent variables. From Table V, it shows that in the 141 survey farmers, the average age is 47.43; the culture period is 7.67 years. The ratio of factory model is 0.74, indicating that the flatfish industry adopts intensive and high-density culture methods, which is deemed as a relatively higher level of modernization. At the same time, there are differences in some variables between culturists with formal loan demand and those without formal loan demand. In terms of aquaculture farmers' endowments, the proportion of loan demand of farmers in Liaoning province is much higher than that in Shandong province in terms of operational characteristics; pond method farmers' loan demand is higher than that of farmers using factory method.

III. EMPIRICAL ANALYSIS

A. Formal Credit Demand Analysis of Aquaculture Farmers

The formal loan demand of aquaculture farmers is analyzed using the Logit model, as shown in the formula (1). Where P_i refers to the existence of formal loan needs. If the culturists apply for loans from formal rural financial institutions, then $P_i = 1$, otherwise $P_i = 0$. X_i refers to the influence factor of farmers' formal loan demand. α_i is the variable coefficient and ε_i is random error.

$$P_i = \alpha_0 + \sum_{i=1}^{n} \alpha_i X_i + \varepsilon_i \quad (1)$$

TABLE VI . LOGIT MODEL REGRESSION RESULTS INFLUENCING THE NORMAL LOAN DEMAND

Loan Demand	Coefficient	SD	Z	P
Constant	3.826	2.550	1.5	0.133
Age	-0.016	0.035	-0.45	0.650
Time	-0.022	0.057	-0.39	0.698
Area	-0.289	0.634	-0.46	0.648
Size	0.012	0.578	0.02	0.983
Incm	0.000	0.006	-0.05	0.957
Expen	0.006	0.007	0.75	0.455
Byway	-1.265	1.066	-1.19	0.235
Link	0.824	0.457	1.80	0.071
Dist	-0.016	0.039	-0.4	0.686
Freq	-0.150	0.102	-1.68	0.086
Ifrela	-0.427	0.629	-0.68	0.497
Log likelihood		-81.426		
LR Chi2		14.47		0.0316
Pseudo R2		0.0716		
Sample number		139		

Table VI shows the Logit model regression results of the factors that influencing farmers' formal loan demand. From Table VI, the "Freq" coefficient is significantly negative at the 10% level, indicating that the more the

number of financial institutions visits to obtain loans, the higher the loan costs the farmers will pay. Thus it leads to the decrease of the loan demand. The "Link" coefficient at the 1% level is significantly positive, showing that farmers who often contact with comprehensive experimental station or agricultural technicians have stronger ability to upgrade the technology and have more motivation for applying loans from financial institutions to expand production and operation.

B. Formal Loan Availability Analysis of Aquaculture Farmers

Among the aquaculture farmers with formal loan demand, if some actually obtain the same loan amount from formal financial institutions as what they apply, the formal loan availability is 1. And if they cannot obtain full applied amount, the formal loan availability will be between 0 and 1. In addition, the total amount of loans received can be 0. This type of dependent variable belongs to the limit dependent variable. This paper uses the Tobit model for regression analysis as shown in formula (2), where Y_i refers to the availability from the formal finance of the culturists, Z_i refers to the factors that influence the formal loan availability of the culturists, β_i is a variable coefficient, and μ_i is a random error term. In addition, Y_i^* is the latent variable, α represents the right intercept point, and β is the left intercept point where $\alpha = 1, \beta = 0$.

$$Y_i^* = \beta_0 + \sum_{i=1}^{m} \beta_i Z_i + \mu_i \tag{2}$$

$$Y_i = \begin{cases} \alpha, & Y_i^* \le \alpha \\ Y_i^*, & \beta < Y_i^* < \alpha \\ \beta, & \beta \le Y_i^* \end{cases}$$

Table VII is the result of Tobit model regression of the factors that influencing the formal loan availability. From Table VII, it shows that the "App" coefficient is significantly negative, indicating that the higher the amount of the applicant's loan application, the lower its availability of loan. In terms of farmers' endowments, the "Area" coefficient is 0.503, indicating that Liaoning Province's farmers enjoy higher loan availability compared with Shandong Province. In the technical characteristics, the "Link" coefficient is significantly positive, indicating that flatfish aquaculture has a higher technology demand and then be able to regularly contact with comprehensive experimental station or technicians. As the technical level and industrial upgrading capacity is higher, flatfish aquaculture can obtain approval from financial department more easily and increase its loan availability. In terms of credit transactions, the "Dist" coefficient is -0.052 and significant, indicating that the farther away from the financial institutions, the worse the loan availability.

TABLE VII . TOBIT MODEL REGRESSION RESULTS OF FACTORS INFLUENCING THE FORMAL LOAN AVAILABILITY

Loan Availability	Coefficient	SD	SD	T
Constant	2.612	1.284	2.03	0.045
App	-0.017	0.005	-3.53	0.001
Age	-0.020	0.017	-1.21	0.229
Time	0.010	0.024	0.43	0.671
Area	0.503	0.285	1.77	0.081
Size	0.035	0.260	0.13	0.894
Incm	0.004	0.003	1.44	0.153
Expen	-0.003	0.003	-1.19	0.238
Byway	-0.188	0.505	-0.37	0.710
Link	0.589	0.298	1.98	0.051
Dist	-0.052	0.020	-2.60	0.011
Freq	0.176	0.070	2.51	0.014
Ifrela	0.444	0.333	1.33	0.186
Log likelihood		-49.547		
LR Chi2		37.67		0.0002
Pseudo R2		0.2754		
Sample number		96		

C. Robustness Test

In order to further analyze the demand and availability of formal loan, it is necessary to further analyze the amount of the loan applied and approved from formal finance. According to the Heckman model, the loan behavior of farmers to the formal financial institutions can be divided into two stages. The first stage is that the culturists apply for loans from financial institutions. The second stage is the analysis of farmers on the loan amount applied and approved. When the inverse Mills ratio obtained by the estimates from the selection equation is added into the regression equation of the second stage, it is found that λ_i is not statistically significant, indicating that the model does not have selective bias. Therefore, the conclusion by choosing the regression model to analyze the factors affecting the scale of the formal loan applied and approved is reliable.

Table VIII shows the regression results of the factors influencing the farmers' formal loan amount. From the table, the "Byway" coefficient is significantly positive, which indicates that compared with the pond culture, factory culture is an intensive culture model which requires large amount of investment and leads to a higher loan application amount from financial institutions. The "Size" coefficient is positive, indicating that the larger the production size, the more funds will be needed and the higher the amount of the loan will be applied.

TABLE VIII . REGRESSION RESULTS OF FACTORS INFLUENCING THE LOAN APPLIED AMOUNT

Amount of Loan Applied	Coefficient	SD	T	P
Constant	-26.833	27.148	-0.99	0.326
Age	0.186	0.379	0.49	0.625
Time	0.020	0.533	0.04	0.970
Area	0.601	5.987	0.1	0.920
Size	11.158	5.832	1.91	0.059
Incm	0.046	0.048	0.95	0.344
Expen	-0.068	0.057	-1.18	0.241
Byway	29.140	11.082	2.63	0.010
Link	7.089	5.032	1.41	0.163
Dist	-0.020	0.395	-0.05	0.961
Freq	-0.139	1.176	-0.12	0.906
Ifrela	5.161	6.167	0.84	0.405
F		2.13		0.0264
Adjusted R2		0.1171		
Sample number		96		

TABLE IX. REGRESSION RESULTS OF FACTORS INFLUENCING THE APPROVED LOAN AMOUNT

Amount of Loan approved	Coefficient	SD	T	P
Constant	-20.727	33.125	-0.63	0.533
Age	0.150	0.462	0.32	0.747
Time	-0.511	0.651	-0.79	0.435
Area	-11.145	7.305	-1.53	0.131
Size	13.599	7.116	1.91	0.059
Incm	-0.018	0.059	-0.31	0.756
Expen	0.014	0.070	0.2	0.839
Byway	39.118	13.522	2.89	0.005
Link	9.635	6.140	1.67	0.080
Dist	0.597	0.482	1.24	0.220
Freq	-2.516	1.435	-1.75	0.083
Ifrela	3.273	7.525	0.43	0.665
F		2.33		0.0151
Adjusted R2		0.1345		
Sample number		96		

Table IX shows the regression results of the factors influencing the farmers' approved formal loan amount. As shown in Table IX, the "Byway" coefficient is significantly positive, suggesting that factory culture is more productive than pond culture. The "Link" coefficient is positive and significant at the 5% level, which indicates that the higher the technical level, the higher the amount of the loan gets approved. "Size" coefficient is positive, indicating that the larger the amount of culture, the higher the amount of the loan gets approved. At the same time, the "Freq" coefficient of loan cost is -2.703, which is significant at the 5% level. It indicates that the higher the loan cost on farmers, the smaller the amount of their loans can be approved.

From the comparison between Table VIII and Table IX, the "Size" coefficient are respectively 11.16 and 13.60, both at the 10% significant level of statistics. It indicates that with the increase of culture area, the amount of loans obtained from regular financial institutions can be higher than what's applied, and it will help aquaculture farmers ease the financing constraints and facilitate the expansion of production and operation. Similarly, the "Link" coefficients are quite different too. Along with the increase of contact between farmers and technicians, the amount of the loan obtained is higher than what is applied, which means credit availability increases. This is consistent with the conclusions in Table VII.

IV. CONCLUSIONS

Based on the survey data from Shandong and Liaoning Province, this paper investigates the factor that influencing the formal loan demand and availability of aquaculture farmers in China. The results show that: (1) Culture area and technical level have positive impacts on loan application. (2)Technical level and the number of bank visit for loans can have a positive impact on the formal loan availability. But the scale of loans and the distance to financial institutions have a negative impact on the formal loan availability. In addition, Liaoning province loan availability is significantly higher than that in Shandong province. (3) Culture area and technical level have positive influence on both applied and obtained amount of the loan. (4) The amount of loans applied and obtained for factory culture are both significantly higher than those of pond culture.

Based on the above conclusions, it is necessary to improve the formal loan's scale and availability for aquaculture farmers. First, strengthen fishery financing guarantee mechanism, and the government should support the development of aquaculture insurance, establish and improve the fishery loan guarantee association, provide loan guarantees to culturists, and promote financial institutions to provide loan funds to the fishery industry. Second, the government should further play a guiding role in promoting the function of Fisheries Technology Extension Station, strengthen financial support for fishermen cooperatives, encourage farmers to form a large-scale operation, perfect the financial system in the main producing areas and encourage financial institutions to strengthen the work for fishery loan.

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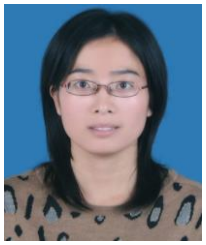

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