Colegio de Postgraduados

Shrimp aquaculture, absorption capacity and competitiveness: an analysis based on the case of Ahome, Mexico

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ABSTRACT

Objective: to present empirical evidence of the effect that the Knowledge Absorption Capacity (AC) and its dimensions have on the competitiveness of shrimp farming companies.

Design/Methodology/Approach: a multiple linear regression analysis was performed to determine the degree of influence of the independent variables (AC dimensions) on the dependent variable (competitiveness).

Results: There was a positive effect between AC dimensions and competitive performance. The capacity for transformation of knowledge was the strongest effect.

Study limitations/Implications: due to time and resource constraints, this study was based on a survey limited to a small number of businesses in the municipality of Ahome (Sinaloa), Mexico. Therefore, these results could be specific to the activity evaluated and to that region.

Findings/Conclusions: studies such as this represent a turning point in exposing the importance of conceiving AC as a complex and multidimensional construct that contemplates the processes of acquisition, assimilation, transformation and exploitation of knowledge.

Keywords: knowledge absorption capacity, competitiveness, shrimp farmers, Ahome.

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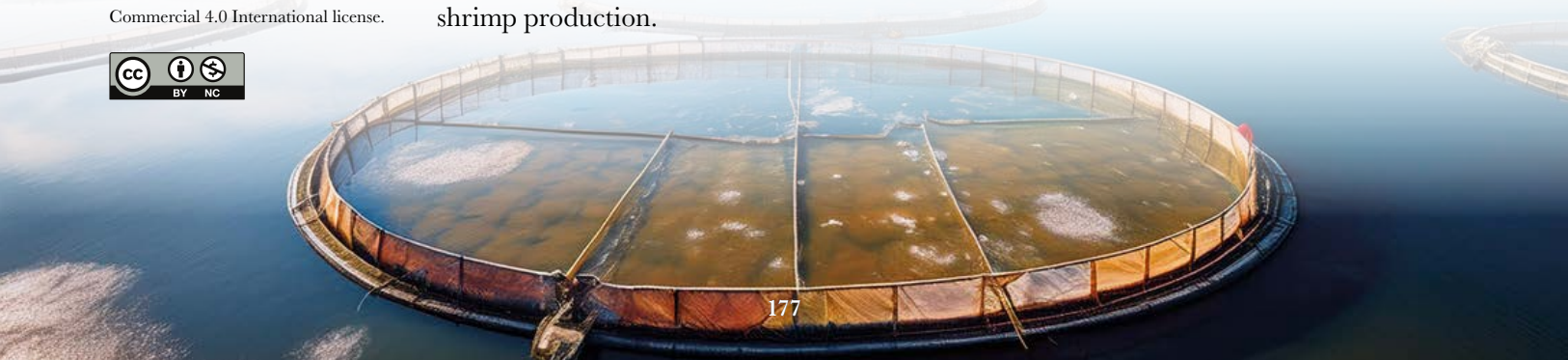
INTRODUCTION

Globally, efficient and productive agrifood systems are key to addressing food security challenges; and involve the adoption of production practices that are economically viable, socially equitable and environmentally responsible. With a view to guaranteeing the availability of quality food for present and future generations without compromising the quality of the environment (Varela and Moraga, 2020). Aquaculture has established itself as a relevant economic activity that has tripled its production globally in recent decades and has directly favoured employment and social welfare in rural areas. In particular, shrimp farming has become an important pillar of global food security and one of the most dynamic agri-food activities. Sinaloa is the state with the highest contribution to national shrimp production.



However, the activity faces great environmental, innovation, biosecurity and mortality challenges. In particular, producers have had to face recurrent epidemics that attack shrimp in situations of stress or environmental disturbances, and cause substantial economic losses (Tang and Bondad-Reantaso, 2020). Therefore, it is crucial that producers are aware of technological advances in areas such as genetic resources, probiotics, production systems with low environmental impact, food, vaccines and treatments, in order to mitigate the economic, social and environmental impacts of the production crises that this activity has presented.

As smallholders with limited resources to invest in their own research and development activities, shrimp farmers in countries with emerging economies seek to access, acquire, and adopt innovative technologies for aquaculture through informal relationships and social networks (León *et al.*, 2020). Producers can obtain information, ideas, and knowledge about technologies from external sources, such as universities and technology institutes, research centers, government agencies, suppliers, competitors, customers, private consultants, among others. But it is one thing to have knowledge providers that allow knowledge to be acquired about new and emerging technologies, and quite another for that knowledge to be learned, internalized, and effectively absorbed by producers.

The ability of shrimp farmers to efficiently obtain and absorb knowledge about new and emerging technologies has been little studied in the regional context. This capacity has been called Knowledge Absorption Capacity (AC) in the administrative sciences (Cohen and Levinthal, 1990). Studies on AC agree that AC is a key factor in the competitive success of companies in the current context of the knowledge economy (De Zubielqui *et al.*, 2016).

There is a significant increase in the literature focused on AC, but important knowledge gaps persist. For example, although several academics have broken down the AC process into particular dimensions (Camisón and Forés, 2010; Flatten *et al.*, 2011), this fragmentation and the importance that each dimension has in business performance are issues that are not completely elucidated, since few studies have focused on the relationships between multiple dimensions of knowledge, AC and company performance.

Therefore, this study aimed to analyze how the particular capabilities that compose AC and the competitive performance of the company are associated, through presenting empirical evidence of the effect that AC and its dimensions have on the competitiveness of shrimp companies in Ahome, Sinaloa.

MATERIALS AND METHODS

The study was quantitative and correlational, to visualize how the dimensions of AC were related to the competitiveness of shrimp farms. The empirical research is limited to the case of aquaculture developed in a productive region located in the north of Sinaloa (the municipality of Ahome), which stands out for its production levels.

Modelo conceptual

Zahra and George (2002) proposed a reconceptualization of AC that is widely accepted and used; they define it as a set of routines and processes through which organizations

acquire, assimilate, transform, and exploit knowledge. According to those authors, acquisition capacity refers to a company's ability to recognize and obtain externally generated critical knowledge. Assimilation refers to the routine operations of the company that allow it to analyze and understand the information acquired. The capacity for transformation allows the development and improvement of procedures that facilitate the combination of existing and new knowledge. Knowledge exploitation capacity is based on activities that help companies to improve and build on existing skills and to establish new ones (Zahra and George, 2002).

Location and characteristics of the study region

Ahome is one of the 18 municipalities of the state of Sinaloa, Mexico. It is the third most important municipality in the state of Sinaloa and a commercial bridge to the northwest of the country. It is located on the Pacific coastal plain, at the entrance to the Gulf of California, and in the heart of a rich agricultural region, the El Fuerte Valley. Ahome is the municipality with the greatest contribution to shrimp production in the state and is one of the most suitable for aquaculture at the national level since it has 120 km of coastline that allow the formation of bays, islands, estuaries and lagoons (Figure 1). The municipality has 11 000 ha available for the development of aquaculture farms, of which approximately 8700 ha are used, with 85 aquaculture production units.

Data

Data was obtained from a survey applied to a sample of 64 aquaculture production units dedicated to shrimp farming in the study region. The survey was applied to farm administrative personnel, such as owners or managers, as it was considered that they should be directly responsible for planning, organizing, directing and controlling aquaculture operations.

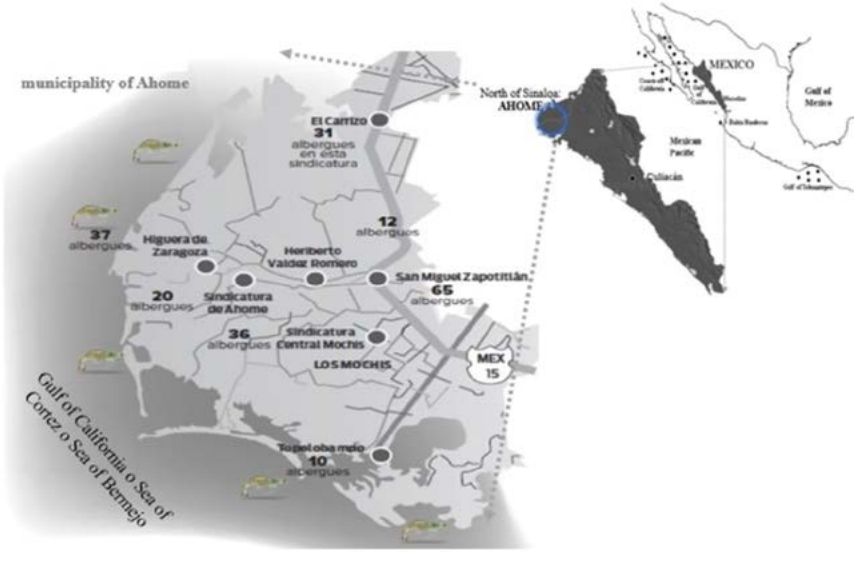


Figure 1. Location of the aquaculture region of Ahome (Sinaloa), Mexico.

The questionnaire consisted of three sections, the first aimed at obtaining information from companies and managers. The second contained the items of the scale designed to measure the different dimensions of the AC, and the last section contained the items to measure the competitive performance of the shrimp farms. Table 1 shows both the variables and the items used in the scale to measure these variables, as well as the sources of previous studies that were taken as a reference for the items used.

Regarding the reliability analysis of the scale, the consistency of the items was evaluated with the Cronbach's Alpha test; values greater than 0.80 were obtained; the measurement of reliability with Cronbach's Alpha assumes that the items (on a Likert-type scale) estimate the same construct and that they are highly correlated.

Table 1. Scale items to measure the dimensions of knowledge absorption capacity (AC) and competitiveness.

Dimensions of the Knowledge Absorptive Capacity
ACQUISITION CAPACITY (Flatten *et al.*, 2011; Tepic *et al.*, 2012; Pradana *et al.*, 2019). 1=completely disagree and 5=completely agree. The farm: - Obtains information on aquaculture technologies through contacts with actors in the sector - Participates in seminars and conferences to update and enrich its technical knowledge. - Allocates enough time for the establishment of contacts with agents that provide information on innovations - Has the skills to establish contacts with agents that provide knowledge and information about innovations
ASIMILATION CAPACITY. (Pradana *et al.*, 2019; Flatten *et al.*, 2011; Müller *et al.*, 2021). 1: completely disagree and 5: completely agree The farm: - Records and stores newly acquired knowledge for future reference. - Has enough skills to recognize changes in technical possibilities. - Allocates enough time to deliberate with advisors in order to recognize technological advances. - Has enough skills to deliberate with advisors on how new technologies can be used in farm
TRANSFORMATION CAPACITY (Pradana *et al.*, 2019; Müller *et al.*, 2021) 1: completely disagree and 5: completely agree The farm: - Recognizes in a timely manner the usefulness of new external knowledge to expand its own internal knowledge. - Allocates enough time for the translation of external information into adaptations to the company's own business. - Has enough skills to translate external information into adaptations to our business.
EXPLOTATION CAPACITY (Tepic *et al.*, 2012) 1: completely disagree and 5: completely agree The farm: - Can translate external information directly into new business applications. - Applies external information to our business to contribute to our productivity. - Has enough skills to convert external information into productive results.
Farm competitiveness
COMPETITIVENESS (Tepic *et al.*, 2012) 1: much smaller and 5: much larger Regarding your farm, how is ….?: - Profitability compared to its competitors. - Market share compared to its competitors. - Product quality compared to its competitors. - Level of exports compared to its competitors. - Cost-benefit efficiency compared to its competitors.

Statistical analyses

First, the data were subjected to a correlation analysis (Pearson and Spearman's Rho), in order to obtain a statistical measure that expressed the magnitude to which the dimensions of the AC had a linear relationship with competitive performance and with each other. Afterwards, a multiple linear regression analysis was performed to determine the degree of influence of the independent variables (the AC dimensions) on the dependent variable (Company competitiveness).

RESULTS AND DISCUSSION

Sample Features

Regarding the size of the companies participating in this study, the vast majority (93.7%) are small and medium-sized enterprises (in Mexico, Pymes). In regard to the age of the companies, 84.4% were founded within the last 15 years. This means that shrimp farming is an activity that has expanded and developed very recently. More than 80% of the companies participating in the survey belong to the private sector, while only 15.6% belong to corporate property, so called social, in particular to the Communal Land System (Table 2).

Correlation Analysis

The results of the correlation analysis indicated that the dimensions of AC were positively correlated with the competitive performance of the company. This means that companies with higher ACs are more likely to perform better competitively. In particular, the variables ASIMIL (assimilation capacity) and TRANS (transformation capacity) showed a positive and significant correlation ($p \leq 0.01$) with competitive performance, with Pearson correlation values of 0.354 and 0.357, respectively.

Table 2. Characteristics of the companies participating in the study.

Size	Frequency	Percentage
1 to 50 Employees	37	57.8
51 to 250 Employees	23	35.9
251 Employees or more	4	6.3
Total	64	100.0
Age	Frequency	Percentage
5 to 10 years old	29	45.3
11 to 15 years old	25	39.1
16 to 20 years old	5	7.8
21 years and older	5	7.8
Total	64	100.0
Sector	Frequency	Percentage
Private	54	84.4
Social	10	15.6
Total	64	100.0

The results of the non-parametric correlation analysis using Spearman's Rho correlation coefficient indicated a positive and significant correlation ($p \leq 0.05$) with competitive performance (COMPE), the variables ASIMIL (0.308), TRANS (0.337) and EXPLO (0.259). The ADQ dimension (ability to acquire knowledge) was the only one that did not present a significant correlation in both implemented tests.

It is important to consider that correlation analysis does not prove causation. However, the results of these analyses suggest that AC is an important factor associated with the competitive performance of aquaculture farms in the region of the municipality of Ahome. Overall, the results of these analyses suggest that those aquaculture farms in the region that wish to improve their competitive performance should focus on improving AC.

Regression Model

The multiple regression model demonstrated the ability to explain 18.1% of the variability in the competitive performance of Ahome's aquaculture companies ($R^2=0.181$, $p<0.05$), as shown in Table 3. It is essential to highlight that the adjusted R^2 value, which considers the number of variables in the model, was 0.126; This means that the model's predictor variables contributed ($p \leq 0.05$) with 12.6% of the variation in competitive performance. This result highlights the relevance of the variables in the model, and supports the idea that they play a crucial role in understanding the competitive performance of aquaculture companies. The probability of error was less than 5% ($p \leq 0.05$), which confirms the validity of the model. In summary, the multiple regression model, when considering the adjusted and significant R^2, provided a solid and relevant view of how variables influence the competitive performance of these companies in the region.

The analysis of variance of the multiple regression model indicated that, for shrimp farms in the municipality of Ahome, the model is better ($p \leq 0.05$) to predict the competitive performance than using only the average performance ($F=3.268$, $p \leq 0.05$; Table 3). The analysis compared variation between groups (in this case, groups of companies with different levels of knowledge and technology absorption capacity) with variation within groups. The F-value is a measure of the proportion of total variation that is attributable to variation among groups. In this case, the value 3.268 indicates that the variation among groups is significantly greater than the variation within the group. This suggests that the dimensions of the AC explain an important part of the variation in the competitive performance of Ahome's aquaculture farms. In other words, companies with higher AC have significantly better competitive performance than companies with lower capacity.

According to the analysis of the coefficients of the model (Table 3), it is observed that the competitive performance of shrimp farms increases to the extent that their capacity to assimilate and transform knowledge increases. However, when examining the individual regression coefficients for each independent variable, only the capacity for knowledge transformation (TRANS) was found to be significant ($p \leq 0.05$). The model includes a constant of 13.029 with a standard error of 4.7 and $t=2.772$ ($p \leq 0.01$). In summary, results indicated that, although the model as a whole is statistically significant, only the individual coefficient of knowledge transformation capacity (TRANS) has effects on the competitiveness of the companies studied.

Table 3. Results of the regression analysis to Competitiveness (COMPE)[a].

COEFFICIENTS						
Model	**Unstandardized coefficients**		**Standarized coefficient**	**t**	**Sig.**	
	β	**Std.error**	β			
1 (Constant)	13.029	4.700		2.772	0.007	
ADQ	−0.015	0.256	−0.008	−0.06	0.952	
ASIMIL	0.278	0.175	0.279	1.59	0.117	
TRANS	0.369	0.186	0.481	1.99	0.050	
EXPLO	−0.636	0.424	−0.371	−1.501	0.139	

MODEL SUMMARY							
Model	**R**	**R^2**	**R^2 adjusted**	**Change statistics**			
				Change of square of R	**Change in F**	**df1**	**df2**
1	.426[a]	.181	.126	.181	3.268	4	59

VARIANCE						
Model		**Sum of squares**	**gl**	**Root mean square**	**F**	**Sig.**
1	Regression	168.228	4	42.057	3.268	.017[b]
	Residual	759.257	59	12.869		
	Total	927.484	63			

[a] Dependent variable: COMPE. Predictors: (Constant), ADQ, ASIMIL, TRANS, EXPLO.

Model evaluation

Evaluation tests of the multiple linear regression model were also performed and the model met the validity criteria for nonparametric tests. It was concluded that the model met these criteria A) normal distribution of residuals (Shapiro-Wilk 0.971; p=0.139); B) homoscedasticity (Breusch-Pagan, 1.135; p=0.286); C) no autocorrelation among residuals (Durbin-Watson 0.307; p=0.128); and D) there was no multicollinearity, the variance inflation factor (FIV) yielded values <10 for each predictor of the model.

The results of the regression model are consistent with those of other studies in which a positive effect of the ability to absorb knowledge has also been found. Either in their capabilities or in particular dimensions of business performance, especially competitiveness and innovation (Xie *et al.*, 2018). They also coincide with those other studies on the matter, arguing that aquaculture companies should consider AC as a driver that helps them achieve a stronger competitive advantage and superior business performance (Lichtenthaler, 2016). AC not only plays a critical role in competitiveness (Camisón & Forés, 2010), but also allows companies to reach leading positions (Tzokas *et al.*, 2015) and to develop dynamic organizational capabilities (Zahra & George, 2002; Camisón & Forés, 2010).

Results also coincide with those of some authors who have only very recently worked in greater depth on research consisting of determining the differentiated role played by AC dimensions in business performance (Zobel, 2017; Kafouros *et al.*, 2020; Knoppen *et al.*, 2022). This research shows that the positive effects of knowledge provided by external

actors to improve performance are not the same for all companies, but depend on certain dimensions of absorption capacity. The particularity of our results is that the capacity for knowledge transformation was the only one with a proven and significant positive effect on competitiveness. It is important to broaden the topic of study to the national context in future research. That is, to move towards determining the type of relationship that exists among different dimensions of AC, as some analysts are already doing in China (Xie *et al.*, 2018).

CONCLUSIONS

This study focused on identifying the effect of the different dimensions of the knowledge absorbtion capacity on competitiveness and highlighted the relevance of conceiving it as a complex and multidimensional construct. It also revealed the importance of the ability to assimilate external knowledge in competitiveness. The reinforcement of this capacity can be achieved through the development of an organizational environment that favors technological learning in all areas of the company to enhance the impact of external knowledge on the acquisition of new technologies.

Shrimp farmers should intensify the links that strengthen their capacities to access external knowledge, to maximize the quantity and diversity of technical information obtained; to link and interact with organizations as varied as possible, such as suppliers, customers, government, universities, research centers and civil associations. The study had some limitations, such as the limited number of farms in a single location. Also, that it presents the different dimensions of knowledge absorbtion capacity as determinants of competitiveness, without considering whether some of them play a role in mediating the effect of others.

REFERENCES

Camisón, C. y Forés, B. (2010). Knowledge absorptive capacity: New insights for its conceptualization and measurement. *Journal of Business Research, 63*(7), 707-715. https://doi.org/10.1016/j.jbusres.2009.04.022

Cohen, W. M., y Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 128-152. https://doi.org/10.2307/2393553

De Zubielqui, G. C., Jones, J. y Lester, L. (2016). Knowledge inflows from market-and science-based actors, absorptive capacity, innovation and performance —a study of SMEs. *International Journal of Innovation Management, 20*(06). https://doi.org/10.1142/S1363919616500559

Flatten, T. C., Greve, G. I. y Brettel, M. (2011). Absorptive capacity and firm performance in SMEs: The mediating influence of strategic alliances. *European Management Review, 8*(3), 137-152. https://doi.org/10.1111/j.1740-4762.2011.01015.x

Kafouros, M., Love, J. H., Ganotakis, P. y Konara, P. (2020). Experience in R&D collaborations, innovative performance and the moderating effect of different dimensions of absorptive capacity. *Technological Forecasting and Social Change*, 150, 119757. https://doi.org/10.1016/j.techfore.2019.119757.

Knoppen, D., Saris, W. y Moncagatta, P. (2022). Absorptive capacity dimensions and the measurement of cumulativeness. *Journal of Business Research*, 139, 312-324. https://doi.org/10.1016/j.jbusres.2021.09.065

León B., J. I., Carrazco E., J. C. y Leyva L., E. (2020). La topología y algunas características clave de la Red de Conocimiento de la acuicultura de camarón desarrollada en Ahome, Sinaloa. Estudios sociales. *Revista de alimentación contemporánea y desarrollo regional, 30*(56). https://doi.org/10.24836/es.v30i56.1032

Lichtenthaler, U. (2016). Determinants of absorptive capacity: the value of technology and market orientation for external knowledge acquisition. *Journal of Business and Industrial Marketing, 31*(5), 600-610. https://doi.org/10.1108/JBIM-04-2015-0076

Müller, J. M., Buliga, O. y Voigt, K. I. (2021). The role of absorptive capacity and innovation strategy in the design of industry 4.0 business Models-A comparison between SMEs and large enterprises. *European Management Journal, 39*(3), 333-343. https://doi.org/10.1016/j.emj.2020.01.002

Pradana, M., Pérez L., A. y Fuentes B., M. (2019). Revisiting measure of absorptive capacity: Applying the scales in spanish wine industry. *Journal of Management Information and Decision Sciences, 22*(4), 515-526. https://mahirpradana.staff.telkomuniversity.ac.id/files/2022/04/LAMPIRAN-B1.8.pdf

Tang, K. F. J., y Bondad-Reantaso, M. G. (2020). Impacts of acute hepatopancreatic necrosis disease on commercial shrimp aquaculture. *Rev. Sci. Tech*, 38, 477-490. https://doi.org/10.20506/rst.38.2.2999

Tepic, M., Trienekens, J. H., Hoste, R., y Omta, S. W. (2012). The influence of networking and absorptive capacity on the innovativeness of farmers in the Dutch pork sector. *International Food and Agribusiness Management Review*, 15 (1030-2016-82924), 1-34. 10.22004/ag.econ.132787

Tzokas, N., Kim, Y. A., Akbar, H., y Al-Dajani, H. (2015). Absorptive capacity and performance: The role of customer relationship and technological capabilities in high-tech SMEs. *Industrial marketing management*, 47, 134-142. https://doi.org/10.1016/j.indmarman.2015.02.033

Varela, A., y Moraga, T. V. (2020). La camaronicultura como fuente sustentable de alimentos de origen animal. Logros, retos y oportunidades. *Ecología y Desarrollo Sostenible, 1*(1). https://revistas.ulatina.ac.cr/index.php/ecologia/article/view/306

Xie, X., Zou, H., y Qi, G. (2018). Knowledge absorptive capacity and innovation performance in high-tech companies: A multi-mediating analysis. *Journal of business research*, 88, 289-297. https://doi.org/10.1016/j.jbusres.2018.01.019

Zahra, S.A. y George, G. (2002): "Absorptive capacity: A review, reconceptualization, and extension", *Academy of Management Review*, vol. 27, nº 2, pp. 185-203. https://doi.org/10.5465/amr.2002.6587995

Zobel, A. K. (2017). Benefiting from open innovation: A multidimensional model of absorptive capacity. *Journal of product innovation management, 34*(3), 269-288. https://doi.org/10.1111/jpim.12361