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Influence of knowledge management infrastructure on knowledge creation processes. A study in the primary sector

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ABSTRACT

Under the theoretical approaches of the *resource-based view of the firm*, the *dynamic capabilities* and the *knowledge-based view of the firm*, the purpose of this paper is to analyze the influence that the knowledge management infrastructure has on knowledge creation processes in primary sector companies, specifically, the aquaculture sector. For the empirical analysis, the SEM-PLS approach was used on a sample of 186 shrimp farms in Ecuador. Results confirm that the environment and organizational structure, and culture influence knowledge creation, while technological resources are not significant. This can be explained by the characteristics of the central activities of the shrimp companies and the assignment of functions. From a theoretical point of view, this paper links the *knowledge-based view of the firm* with the activities of the primary sector. Specifically, a theoretical model is developed in which the variables that can influence the knowledge creation processes of shrimp farms are studied. Existing works in the scientific literature that analyze both perspectives are practically nil. From a managerial perspective, given the importance of the creation and renewal of knowledge to develop organizational capabilities in the face of the dynamism of the market, the findings of this study can guide managers to understand how the combination of resources can help increase stocks of knowledge useful to business objectives.

1. Introduction

Globalization and the evolution of technology have generated numerous changes in the structure of markets and in the way firms compete. In the knowledge society, knowledge is identified as the main factor of production and the most valuable resource of companies for the generation of sustainable competitive advantages [1]. The creation of knowledge is linked with the development of dynamic capabilities, which provide firms with the necessary flexibility to adapt to new market conditions [2]. Thus, to cope with the dynamism of the environment, the renewal and creation of knowledge are critical processes for the maintenance of the company in competitive scenarios [3]. Shannak, Ra'ed and Ali [4] point out that the objective of knowledge management is the administration of the knowledge that is most important to the organization. Therefore, managers must create the right conditions to ensure that people have the knowledge they need, at the right place and at the right time.

There are numerous scientific publications that highlight the growing interest of academics in analyzing the creation of knowledge as a way of developing distinctive capabilities that are difficult to reproduce [5–8]. However, they tend to focus on analyzing companies in the secondary and tertiary sectors, characterized by medium and medium-high technological intensity, and by

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knowledge-intensive services, leaving aside primary sector companies, whose levels of technology and knowledge are usually low. In the scientific literature, there are hardly any works referring to the primary sector [9–12].

To fill this gap in the literature and based on the *resource-based view of the firm* [13,14], the *dynamic capabilities theory* [3,15] and the *knowledge-based view of the firm* [1,16], the purpose of this work is to analyze the influence that the knowledge management infrastructure has on the knowledge creation processes in primary sector companies. More specifically, in companies belonging to the aquaculture sector.

The research question that this study considers is the following: do the environment and structure, the organizational culture, and the availability of technological resources influence the creation of knowledge in primary sector companies?

To answer the research question formulated, this research analyses the activities of a population of shrimp farms in the Province of El Oro, Ecuador. The choice of this geographic and sectoral context is justified for two main reasons. First, because shrimp production is one of the main export earners for the country. Second, for its contribution to the economic and social development of the province of El Oro.

This paper offers theoretical and managerial contributions. From a theoretical point of view, its findings contribute to the literature of knowledge management in terms of the creation of knowledge in the primary sector, which differs, both in structure and behavior, from the more widely studied secondary and tertiary sectors. Specifically, a theoretical model is developed in which the causal relationships between the environment and structure, culture, and availability of technological resources of aquaculture companies and their knowledge creation processes are shown. From a managerial point of view, an attempt is made to promote a greater understanding of the value of knowledge as a source of competitiveness. This approach can help managers with their knowledge management decisions towards the creation of useful knowledge for business purposes. Findings obtained allow managers of aquaculture sector firms to identify variables that capitalize knowledge creation and allow the renewal of existing knowledge. Moreover, this research can be considered as a starting point to approximate the organizational practices of firms that belong to an economic activity of great importance for food safety.

The structure of the paper is as follows: after the introduction, a literature review is carried out from which a theoretical model is developed and three hypotheses are formulated. Subsequently, the methodology used and the operationalization of the variables are described. Findings obtained and their discussion are detailed in Sections 4 and 5. Finally, the conclusions, the main limitations and the future lines of research derived from this study are presented.

2. Literature review and model development

2.1. Theoretical foundations

In the current dynamic markets and under the *resource-based view of the firm* [13,14], the competitiveness of firms is associated with how they manage knowledge as a strategic resource. This approach highlights the value and uniqueness of internal resources along with the development of capabilities to make them difficult to imitate. The *dynamic capabilities* approach highlights the importance of developing internal organizational capabilities by identifying external resources and integrating them with internal resources. In the context of this research, knowledge creation implies changes in organizations. Kump et al. [17] consider that dynamic capabilities are crucial for firms that seek to achieve strategic change or renewal. This explains why the *dynamic capabilities* approach is one of the theoretical foundations of this study. These capabilities help firms respond to the changes derived from the constant transformations of the environment [3,15]. They are organizational capabilities that allow firms to expand and renovate their resources, reconfiguring them to innovate and respond to changes in the market and business environment [3].

The previous theoretical approaches are complemented by the *knowledge-based view of the firm*, which highlights the need to put into practice a series of activities aimed at creating, disseminating and applying knowledge [1,16]. These theoretical contributions reinforce interest in the use of knowledge as a strategic resource to increase the possibilities of creating value [16,18].

Firms, regardless of their size, sector or geographic origin, face the need to develop capabilities to cope with the dynamism of the environment and provide coherent responses to new market demands, thus maintaining their competitive advantages. Knowledge management as a business strategy has gained great importance and plays a fundamental role in the implementation of activities that improve performance, innovation and business sustainability in ever-changing environments [5].

2.1.1. Knowledge creation

Several authors agree that the main dimensions of knowledge management are the creation, transfer and application of knowledge [19–22]. According to the proposed objective, this research focuses on the knowledge creation dimension.

Knowledge creation is a process of social interaction in which individuals exchange knowledge, resulting in the change of mental models, through the incorporation of new and different elements to the stock of existing knowledge. The transformation of individual into organizational knowledge happens in a context where guidelines are defined to transform individual tacit knowledge into codified knowledge, thus favoring its transfer and collaboration between individuals [23].

Several studies state that firms create value by combining the exploitation of internal knowledge and the exploration of external knowledge [24,25]. Both sources of knowledge creation strengthen the capability of firms to integrate new knowledge, exploit new opportunities and develop innovative responses [26]. Thus, organizational ambidexterity arises as a capability to adapt to new conditions derived from dynamics and changes in the business environment.

However, knowledge is intrinsic to human beings and is contained in what they know and their skills. Organizational knowledge is associated with social construction and the appropriation of knowledge by the organization. In this sense, the role of managers is key to

facilitate the conditions that stimulate the creation of new knowledge while generating value for the organization [27].

Alavi and Leidner [20], Gold et al. [21] and Mills and Smith [22] consider that the critical variables that affect knowledge creation processes are: 1) the environment and the organizational structure; 2) organizational culture; and 3) technological resources. Each of them is described below.

2.1.2. Environment and organizational structure

The 'environment and organizational structure' variable brings together the strategy, structure, procedures, incentives and communication systems. These elements favor work environment conditions that stimulate individuals towards knowledge management and collaboration. All of them provide a formal orientation for the execution of actions related to the development of knowledge, requiring their joint action to generate value from this resource.

Considering the nature of knowledge, human resource management and knowledge management are linked processes. The main function of human resource management is to strengthen the capabilities of employees according to the organizational strategy [28]. To do this, HRM resorts to mechanisms that reinforce a social environment that motivates employees to achieve the objectives of the organization over and above individual interests [29] and, therefore, to align with the main strategy [4].

Two strategies stand out in the construction of knowledge. On the one hand, the personalization strategy, which focuses on the generation of tacit knowledge through face-to-face interaction between collaborators. On the other hand, the coding strategy, which refers to the formalization of knowledge and the obtaining of explicit knowledge to facilitate its transfer [30,31].

An inappropriate organizational structure can block actions that contribute to knowledge creation. A bureaucratic and hierarchical structure makes communication and knowledge exchange activities difficult, while a flexible structure enables the social construction of knowledge. Similarly, an organizational structure that encourages teamwork and allows decentralized actions will strengthen the empowerment of individuals, enabling them to gain confidence to explore external knowledge, which will serve to propose creative solutions to the problems they face [21,32].

However, to make the strategy and structure operational, formalized processes are required to guide organizational routines and patterns of action in the acquisition and creation of new knowledge. In this sense, explicit knowledge has the greatest potential to materialize in a set of formal mechanisms such as rules, instructions and procedures [5,22].

Reward systems have the ability to reinforce commitment and encourage employees to work better [33] and they are how organizations measure and recognize the performance of their collaborators [34]. They imply a proactive approach to encourage the participation of collaborators and the circulation of knowledge. Transparency in the information of the incentive programs encourages individuals to modify their behavior regarding cooperation and exchange of knowledge. While incentives for team performance contribute to a higher level of knowledge exchange, individual incentives would be detrimental as they are inconsistent with the culture required to promote adequate knowledge creation [35].

According to these arguments, the idea of joint knowledge creation among the elements that make up the environment and the organizational structure is reinforced, from which the first hypothesis is raised:

H1. The environment and the organizational structure positively influence knowledge creation.

2.1.3. Organizational culture

Organizational culture is defined as a set of beliefs and expectations, shared by the members of an organization, that interact under a pattern of basic expectations about their context [36]. Culture will influence the definition of the value of knowledge [5] and the creation of value from knowledge assets [37].

Alavi et al. [20] suggest that the set of values, beliefs and behaviors of individuals in relation to knowledge assets influences the results of their management. Therefore, there are several authors who consider that organizational culture constitutes the main element to facilitate knowledge creation processes [38,39]. In order to facilitate these processes, Intezari et al. [40] point out that the organizational culture must promote positive attitudes towards the exchange of knowledge between individuals, helping to identify and integrate the knowledge of all of them and allowing its availability to the entire organization. For this, culture must be complemented with incentive policies that help create an environment that favors the exchange of knowledge among employees.

The willingness of collaborators to actively participate in knowledge processes can also be influenced by the daily practices of the firm [20,41] and will depend on whether the culture of the company is process-oriented or results-oriented. From the studies by Al Saifi and Chang [37] and Lin [42], it appears that employees are reluctant to take risks when their performance is guided by a process-oriented culture. Belassi et al. [34] and Rahman et al. [43] state that, under a culture that promotes results, collaborators are more likely to develop their creativity when proposing, exchanging and applying innovative responses to achieve the organization's objectives.

Serenko et al. [44] consider that, in business environments that require quick responses, the development of an organizational culture focused on knowledge management leads members to consider knowledge as a social resource that must be shared to create synergies. In the same way, Belassi et al. [6] and Goswami and Agrawal [43], point out that an open and results-oriented culture promotes the exchange of knowledge with suppliers and customers, fostering cooperative relationships that can be used to create new solutions and products. On the contrary, a culture that does not promote the organizational values of sharing will influence the perception of property [34,37], considering knowledge as a source of power and confronting workers with the dilemma of not sharing it.

Following the arguments presented, the second hypothesis is proposed:

H.2. Organizational culture positively influences knowledge creation.

2.1.4. Technological resources

Technological resources are a fundamental component in the implementation of knowledge management systems. In combination with other resources and the action of people, technological resources provide the basis for effective knowledge management, improve the performance of organizations and influence the possibilities of generating competitive advantages [45]. They contribute to the integration of information and knowledge, and its encoding, transfer and storage. They facilitate the activities of search, processing and retrieval of stored knowledge.

Al Busaidi et al. [46, p. 35] state that "the most common information and communication technology (ICTs) used by small and medium enterprises (SMEs) are mobile phones, PCs, PCs with local network connected (intranet), email and electronic data interchange, Internet and an own website". Expert directories, discussion forums, knowledge repositories and tools for decision-making are additional instruments pointed out by Wei et al. [47]. Knowledge repositories facilitate the dissemination of knowledge through tools such as the intranet and virtual communities.

Mastering technological resources increases the possibilities of acquiring, capturing, transferring and applying knowledge [48]. The availability of knowledge bases and tools for the analysis of information can improve the knowledge that collaborators possess while contributing to the identification of the knowledge that can be useful in making decisions to achieve organizational objectives. Del Giudice and Della Peruta [49] state that technological resources allow collaborators to access new knowledge and solve problems with new inputs. Therefore, the use of technological resources contributes to the identification and creation of new knowledge.

However, the availability of a technological infrastructure and its implementation, by themselves, are not enough to guarantee the success of the knowledge creation processes [22]. According to Janet and Alton [38], Serenko et al. [40], Intezari et al. [44], and Hwang et al. [50], it is necessary to encourage positive behavior among collaborators towards the creation of knowledge, as well as a set of attitudes and commitments that is strengthened in the context of an organizational culture oriented towards learning.

Consequently, the availability of technological resources, together with the capacity for their use, contribute to effective knowledge management, which begins with the knowledge creation process [31,51].

Considering the previous ideas, the third hypothesis is formulated:

H.3. Technological resources positively influence knowledge creation.

Fig. 1 shows the research model and the hypotheses formulated.

3. Methodology

3.1. Sample and data collection

The population under study is made up of shrimp farms located in the province of El Oro, Ecuador. The selection of the population is justified by the interest of this study in analyzing the processes of knowledge creation in the primary sector, specifically in the production of aquaculture foods. Shrimp production in El Oro is one of the fastest growing businesses in the world, strengthening its contribution to food security and job creation. Ecuadorian shrimp exports are the second highest non-oil earner and the province of El Oro is one of the areas with the highest production in the country.

To obtain the population, the databases of the Vice Ministry of Aquaculture and Fisheries and the National Institute of Fisheries (NIF) were used as data sources, obtaining 630 shrimp farms in the province of El Oro in 2019. According to the National Institute of Statistics and Censuses (NISC) for the classification of companies, the criterion of small firm (at least 10 employees) was adopted.

Previous studies carried out in the shrimp producing sector from the perspective of knowledge management [11,12], identified the lack of willingness of employers to respond to surveys by phone and email. Consequently, it was decided to apply convenience sampling, a non-probability sampling technique which allows the researcher to include individuals who are accessible to participate and meet the previously defined characteristics. Several works have used this sampling technique in the field of knowledge management [8,52,53]. Applying convenience sampling, 200 shrimp farms firms decided to participate in the study.

To collect the information, a structured questionnaire[1] in Spanish was used, which was designed in several stages. First, an extensive review of the literature in English was carried out to identify the variables to be used. Once the variables were identified, they were translated into Spanish and the corresponding questions were formulated. Second, the questionnaire was discussed with a group of experts made up of researchers in the field of strategic management and knowledge, as well as aquaculture engineers. Third, a pilot test was carried out by means of a personal interview with five managers of shrimp farms, whose feedback contributed to reformulating some questions to adjust them to the specific context of the study. These three stages justify the content validity of the questionnaire [54]. The final questionnaire was made up of a total of 31 questions (see Annex I).

The questionnaire was applied through a personal interview with the CEOs of the 200 participating firms. The CEOs were chosen because they are often the owners of the shrimp farms and have the greatest knowledge of the organizational practices that are

[1] In Ecuador, in the university environment, researchers must abide by and respect the Code of Ethics, regulations, instructions, committees and other regulations corresponding to the disciplinary regime, ethics for research, ethics for research on human beings and management of biological resources or genetic, depending on the research in question. However, there is no specific regulation in the field of social research.Regarding the research presented in this paper, the support of the directors of the producer organizations was obtained to mediate in the acceptance of the partners to respond to the survey. The application of the final questionnaire was carried out personally and in person to the informants (shrimp producers), and took place during the meetings of the organizations in which the partners participated.

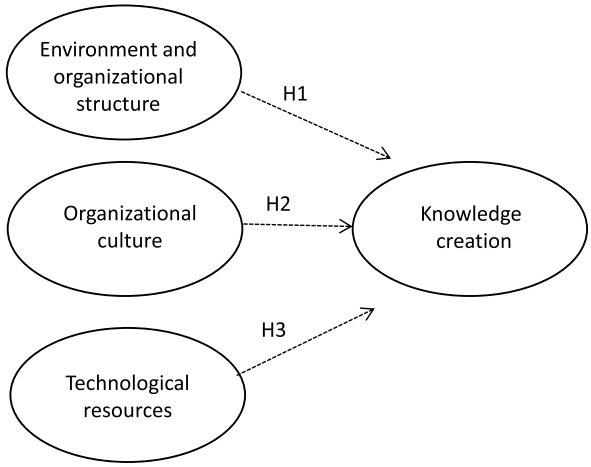

Fig. 1. Research model and hypotheses.

implemented in their companies. In the end, 186 valid interviews were obtained.

3.2. Statistical technique

To test the hypotheses, a Structural Equation Model (SEM) using the Partial Least Squares (PLS) technique was used [6]. PLS is distinguished by having a more flexible approach than other techniques to the size of the sample, by not requiring normality of data [55] and is suitable for the causal analysis of phenomena whose theory has not been sufficiently developed [56]. The reasons that justify the choice of the SEM-PLS approach for this study are the following: (1) The research uses a sample of 186 observations; (2) The constructs of the model are not directly observable and their values have been obtained from subjective measures; (3) This is an emerging theoretical approach. There are few studies in the literature applied to the primary sector under the knowledge management approach. Specifically, in the shrimp production activity, no studies have been identified that explore the processes of knowledge creation.

3.3. Measures

The variables used in the study were obtained from previous works and were adapted for the purpose of the research. All of them are constituted as first-order constructs with formative indicators (Mode B) and were measured with a five-point Likert scale (1 = totally disagree; 5 = completely agree) following the works of Chong and Chong [52] and Ho et al. [57]. Table 1 shows the variables used in the questionnaire.

Fig. 2 shows the research model and its indicators.

4. Findings

The Smart PLS.3.3.3 software was used for data analysis. The evaluation of the model through the PLS technique was carried out in three steps [59,60]: global model assessment, measurement model assessment and structural model assessment.

4.1. Global model assessment

Several measures can be used to evaluate the global fit of the model. The most commonly used is the standardized root mean square residual (SRMR) index. Following Hu and Bentler [61], the SRMR index should be less than 0.08 for a good model fit. In this research, the value for SRMR is 0.072, which indicates a good global fit of the proposed model.

4.2. Measurement model assessment

When the indicators are formative, the measurement model assessment (Mode B) must include the analysis of multicollinearity and the analysis of the relevance and significance of the indicator weights.

Multicollinearity analysis is performed using Variance Inflation Factor (VIF). According to the literature, a VIF value < 3.3 is acceptable and it means that there is no multicollinearity [55]. The results collected in Table 2 indicate that the constructs do not present multicollinearity problems.

The weights of the indicators show the magnitude of their contribution to the respective construct. The higher the weight of the indicator, the greater its contribution [55]. The 5000-sample non-parametric bootstrapping technique was used to obtain the *t*

Table 1
Variables.

Variable	Items
Dependent variable	
Knowledge Creation (KC)	**KC1.** The company promotes training in alliance with public institutions
First-order construct made up of six formative indicators [20,21,51]	**KC2.** The company promotes and takes advantage of training opportunities provided by external actors such as unions or the National Chamber of Aquaculture
	KC3. The company takes advantage of the relationship with suppliers to strengthen their knowledge through advice and training
	KC4. The company updates its knowledge by attending shrimp sector fairs that bring together suppliers and competitors
	KC5. The changes in processes have been generated by internal initiative
	KC6. In the last 3 years, customer suggestions for the improvement of processes and products have been incorporated
Independent variables	
Environment and organizational structure (ENV)	**ENV1.** The company promotes and communicates the vision and mission
First-order construct made up of eight formative indicators [33,44,45]	**ENV2.** The essential production processes are documented
	ENV3. The documented processes provide enough information and guidance for the execution of the work in each department
	ENV4. The organizational structure of the company facilitates communication and information exchange
	ENV5. Managers schedule meetings with all departments to learn about problems or news with those responsible for each function
	ENV6. The jobs at the operations level are described and documented
	ENV7. The firm maintains a process for evaluating workers
	ENV 8. An incentive mechanism is applied for workers based on production levels
Organizational culture (OC)	**OC1.** The application of institutional values and policies is promoted
First-order construct made up of eleven formative indicators [37,52,57]	**OC2.** Managers encourage active communication between departments to solve everyday problems
	OC3. There is an environment that encourages continuous learning
	OC4. The importance of strengthening individual and collective knowledge is disseminated
	OC5. Teamwork is promoted from top management
	OC6. The priority skills required of workers in the different departments of the firm have been identified
	OC7. There is a level of tolerance regarding the errors of workers in the stage of learning new knowledge
	OC8. In this firm, employees demonstrate a high level of responsibility and commitment to the assigned processes
	OC9. In this firm a trustworthy, pleasant environment is perceived to work and develop professionally
	OC10. The level of turnover is high in the operations positions
	OC11. The level of rotation is high in the positions of specialized technicians in production and control
Technological resources (TR)	**TR1.** The firm uses ICTs to monitor customer opinions
First-order construct made up of six formative indicators [21,47,58]	**TR2.** ICT learning is promoted through scheduled training
	TR3. Production and control records are digitized
	TR4. In the last 3 years, investments have been made to update the technological resources available for information management
	TR5. There is a certain dependence on collaborators who manage the company's own computer systems
	TR6. There are computer systems in all departments that allow access to and share information internally
Control variables	
Size	Number of employees in the company and the area of the shrimp farms in hectares
Age	Number of years since the creation of the firm (accumulated experience)

statistics and the confidence intervals, which serve to assess coefficient significance. According to the theory, all weights should be positive and have a *p* value below 0.05 to be significant. After the analysis, indicators that presented negative signs or had a very low weight were eliminated.

Table 2 shows the results of the measurement model assessment once the indicators have been refined. It can be observed that all the weights are positive and, except for three of them, all are significant. We decided to not eliminate these three indicators because, according to Chin [56], eliminating an indicator could reduce the information to explain the construct they make up.

4.3. Structural model assessment

The structural model is evaluated by: (1) the assessment of the determination coefficient (R^2); (2) the assessment of the algebraic sign, magnitude and statistical significance of the path coefficients; (3) the assessment of the predictive relevance (Q^2) of the dependent variable.

(1) The value of R^2 is 0.378, which indicates that 37.8% of the variance of knowledge creation is explained by the independent variables of the model (environment and structure, culture and technological resources); (2) To evaluate the path coefficients, the bootstrapping technique was used, which finds the standard error, the "t" statistics for each path coefficient and the confidence intervals. With these elements, hypotheses can be tested. Table 3 shows the sign and magnitude of the path coefficients. It is verified that there are positive signs for Hypotheses H1 and H2, and a negative sign for Hypothesis H3; (3) To assess the predictive relevance of the structural model, the Stone-Geisser test (Q^2) was applied. According to Chin [56], the value of Q^2 must be greater than 0 and positive. In our study, the value obtained from the *Blindfolding* procedure for Q^2 is 0.106, so it can be stated that the proposed model has

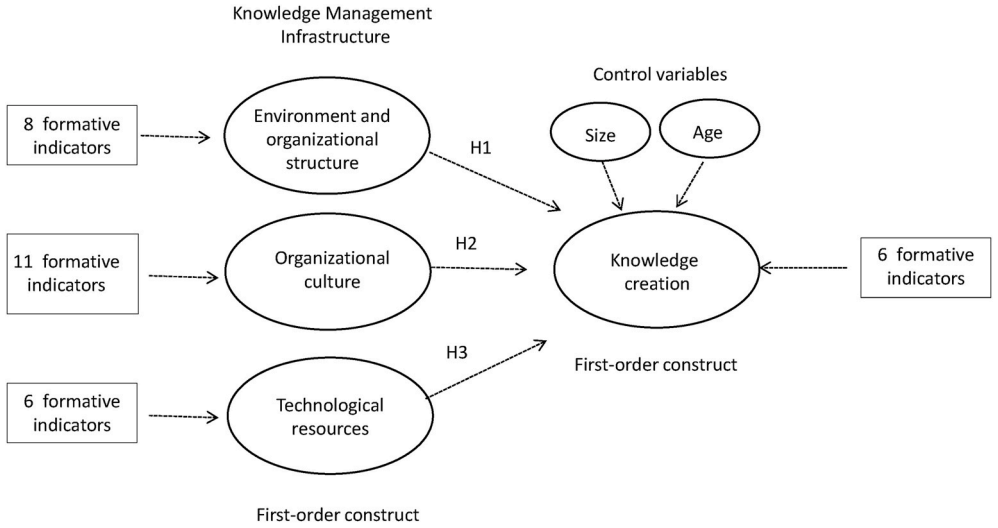

Fig. 2. Research model and indicators.

Table 2
Measurement model assessment.

Constructs	VIF	Weights	P-Value	5.0%	95.0%
Knowledge creation (first order factor)					
KC2	1.063	0.383	0.000***	0.212	0.537
KC4	1.06	0.426	0.000***	0.18	0.658
KC5	1.277	0.669	0.000***	0.439	0.801
KC6	1.289	0.164	0.006*	0.244	0.333
Environment and organizational structure (first order factor) (formative indicators)					
ENV1	1.193	0.255	0.004**	0.093	0.421
ENV2	1.361	0.294	0.001**	0.135	0.436
ENV3	1.407	0.437	0.000***	0.263	0.596
ENV5	1.419	0.197	0.007*	0.076	0.262
ENV6	1.405	0.19	0.008*	0.107	0.254
ENV7	1.24	0.186	0.169 (ns)	0.09	0.265
ENV8	1.368	0.326	0.000***	0.137	0.48
Organizational culture (first order factor) (formative indicators)					
OC2	1.435	0.241	0.003**	0.07	0.385
OC5	1.338	0.124	0.007*	0.046	0.265
OC6	1.359	0.116	0.009*	0.048	0.232
OC7	1.426	0.074	0.216 (ns)	0.087	0.228
OC8	1.388	0.251	0.004**	0.036	0.441
OC9	1.632	0.185	0.006*	0.00	0.4
OC10	1.966	0.417	0.000***	0.208	0.58
OC11	2.067	0.106	0.008*	0.135	0.324
Technological resources (first order factor) (formative indicators)					
TR1	1.094	0.254	0.003**	0.046	0.41
TR3	1.654	0.244	0.003**	0.004	0.518
TR4	1.422	0.435	0.000***	0.241	0.618
TR5	1.441	0.282	0.002**	0.048	0.452
TR6	1.721	0.198	0.035 (ns)	0.012	0.384

Note (s): p*<0.05 (significant to 99.95%), p**<0.01 (significant to 99.99%), p***<0.001 (significant to 99.999%).

predictive relevance for the knowledge creation variable.

Results show that the control variables are not significant, so they do not have a relevant relationship with knowledge creation.

5. Discussion

Findings confirm H1, which shows that the environment and the organizational structure positively influence knowledge creation. These findings are consistent with the widely cited literature in the field of knowledge management [21,22]. To be managed effectively, knowledge creation processes require formal mechanisms for organizing and controlling talent [22]. A flexible organizational structure favors the construction of knowledge, to the extent that autonomy and creativity are promoted among collaborators to take

Table 3
Structural model assessment.

	Path coefficient	P-value	5.0%	95.0%
Environment and organizational structure- > Knowledge creation	0.411	0.001**	0.166	0.615
Organizational culture - > Knowledge creation	0.237	0.007*	0.01	0.518
Technological resources- > Knowledge creation	−0.073	0.302 (ns)	−0.295	0.161
Age - > Knowledge creation	−0.089	0.144 (ns)	−0.222	0.054
Employers - > Knowledge creation	0.233	0.022 (ns)	0.05	0.425
Hectares - > Knowledge creation	−0.263	0.036 (ns)	−0.522	−0.042

Note (s): p*<0.05 (significant to 99.95%), p**<0.01 (significant to 99.99%), p***<0.001 (significant to 99.999%).

advantage of internal and external knowledge [1,21]. Collaboration with strategic partners as external knowledge sources could provide important insights for SMEs [62]. The definition of strategies for the construction of knowledge, personalization or coding, contributes to improving task planning, organization and saving resources [30,31]. In a complementary way, a positive organizational environment for the creation of knowledge is reinforced by the existence of clear performance evaluation systems and rewards for both individual and organizational performance. The perceived opportunities in the organizational structure motivate collaborators to use their cognitive capacities in the creation of knowledge [33,34].

In the context of shrimp farms, the evidence indicates that there is an organizational structure that encourages employees to maintain active participation through internal communication and collaboration that encourages the creation of new useful knowledge. Thus, knowledge creation translates into better decisions associated with production, alerts for the detection of diseases, actions to reduce the mortality of larvae, proposals for the elimination of invasive species, assessment of the water and soil quality of production pools.

The results obtained also confirm H2, which indicates that the organizational culture positively influences knowledge creation. Olan et al. [63, p. 315] point out that 'it is strongly believed that the knowledge creation process is not only culturally situated but also stems from a specific cultural context". Findings are in the same line of the works of, Alavi et al. [20], Janet and Alton [38], Atapattu and Jayakody [39] and Intezari et al. [40]. Atapattu and Jayakody [39] point out that the success of knowledge processes largely depends on the existence of an organizational culture aligned with knowledge management. In the organizational environment, the main source of knowledge are people, whose dominant values and beliefs can contribute to promoting or limiting the organization's ability to create knowledge [21,64]. Therefore, it is essential to influence staff through a set of values and daily practices that reinforce communication, trust, and teamwork [40]. According to Janet and Alton [38], knowledge creation processes are strongly influenced by organizational culture, highlighting the entrepreneur's leadership to guide towards a culture open to learning and knowledge exchange that activates mental agility and ability to create ideas and solutions. At the same time, the authors highlight the need to encourage a high level of social interaction between entrepreneurs and collaborators through respect and mutual trust, which can ultimately lead to the creation and sharing of knowledge.

In the shrimp farms analyzed, the strengthening of individual and collective knowledge is promoted through collaboration with external agents. Thus, knowledge creation is strengthened from relationships with government control institutions, suppliers, customers, and attendance at training events and sector fairs.

Findings do not confirm H3, so it is not possible to affirm that the existence of technological resources in the firms analyzed positively influences knowledge creation. These results are contrary to expectations and it is considered that they could be explained by the characteristics of the shrimp production activity, specifically by its low level of technology. In the shrimp farms analyzed, the registers of feeding, production and news are organized manually by the staff who do the field work. The digitization of the records is carried out by the administrative staff in the offices, outside the production farms, where the field staff is concentrated. Managers and technicians communicate with workers via radio, directly through monitoring and supervision visits in aquaculture farms and through personal meetings with work teams. Findings obtained are far from showing the existence of 'smart farming' [65].

However, it has been observed that commercial departments do invest in technological infrastructure. According to Vijay and Raju [66] and Gu et al. [67] ICTs can be used as a tool to improve supply chain resilience and supply chain performance. In fact, the study of Vijay and Raju [66] about harvested shrimp in Kerala showed that the usage of ICTs allowed buyers to contact sellers and avoid a price drop in the near market.

The results of the study of Ulhaq et al. [68, p. 1] suggest that "ICTs service providers should collaborate with local aquaculture departments to develop pilot farms to showcase new aquaculture technologies and demonstrate key features and their compatibility with existing farms' infrastructure, which will consequently entice farmers to quickly adopt shrimp monitoring technologies".

In this research, although technological resources are not significant for knowledge creation, their availability and the skills to use them are probably used to strengthen communication and knowledge transfer. This reflection is supported by Harif et al. [69] when they state that ICTs accelerate the collection and transmission of the information necessary to acquire external knowledge and integrate it into the firm.

6. Conclusions

An extensive literature has suggested the importance of creating and updating knowledge in companies to adapt to changing market conditions [5,7,25,29]. However, attention has been focused on the secondary and tertiary sectors, finding practically no

studies that analyze knowledge creation in primary sector firms. Some exceptions are the works of Matute et al. [9], Ospina et al. [10], Claver-Cortés et al. [11] and González-Illescas and Campuzano-Vázquez [12].

The research carried out has aimed to fill this gap by analyzing the influence that the knowledge management infrastructure has on the knowledge creation processes of shrimp farms. To that end, an extensive review of the literature was carried out, which led to the development of a model with a set of causal relationships embodied in three hypotheses. To test the model, the quantitative methodology based on SEM-PLS was used on a sample of 186 shrimp farms located in the province of El Oro, Ecuador.

Findings confirm that the environment and the organizational structure, as well as the organizational culture, have a direct and positive influence on the knowledge creation of firms in the primary sector [21]. Accordingly, in shrimp farms in Ecuador, a combination of formal elements to organize the work around knowledge exist. An organizational structure that favors the exchange of information and the existence of incentive mechanisms that favor knowledge creation is revealed. In addition, the results indicate that, in the firms analyzed, the organizational culture leans towards individual and collective learning, as well as teamwork, which is reflected in the behavior of the workers when generating initiatives to solve everyday production problems.

The empirical evidence also reveals specific implications for technological resources. Findings lead us to identify contextual factors of productive activity that differentiate the perception of entrepreneurs regarding the usefulness of technological resources. Thus, in the aquaculture sector, investment decisions in technological resources are mainly reserved for production activities, with these resources not influencing knowledge creation in shrimp farms. However, these firms cannot neglect the availability and use of skills of technological resources, since in combination with other resources, they could support knowledge transfer and application processes.

From this research, some contributions in the theoretical and practical fields can be identified.

6.1. Theoretical contributions

To our knowledge, this is the first quantitative study under the *knowledge-based view of the firm* approach applied in companies in the primary sector, specifically in the shrimp-producing sector. Despite the growing interest in research on knowledge creation, there is little empirical evidence in developing countries. In this study, the influence of the knowledge management infrastructure on knowledge creation processes has been empirically tested with a sample of Ecuadorian companies, which has made it possible to reveal significant contextual factors for knowledge creation practices in the aquaculture sector. The scale developed to measure the variables has been adapted to the context of the object of study, which is a contribution to the measurement of the creation of knowledge in firms in the primary sector. This study closes the gap identified in the existing scientific literature, by broadening the understanding of knowledge creation practices in the context of primary sector firms, which differ from other widely analyzed sectors. This research provides a viable approach to assess knowledge creation in developing countries.

6.2. Practical contributions

The primary sector is characterized by including economic activities linked to export markets, which undergo continuous changes based on regulations and consumer behavior. This study contributes to raising awareness among entrepreneurs about the role of the creation and renewal of knowledge in responding to the dynamism of their environment. Starting from the internal needs and problems of the organization, knowledge management foresees that knowledge initiatives are linked to real needs and practical challenges that are revealed in the markets [4]. Hence, the importance of analyzing external information on the markets and their regulations and using it to create knowledge that can be used by the company.

In an organizational environment strengthened by strategically oriented actions, opportunities for the identification, renewal and expansion of knowledge assets increase. In this way, organizations can strengthen their ability to compete based on the learning arising from their involvement in knowledge processes. The results obtained in this research could guide shrimp farm managers to invest in a combination of resources: environment and organizational structure, and cultural and technological resources to facilitate knowledge creation processes. These companies may recognize the need to implement or adjust strategies to ensure the deployment of knowledge creation as a relevant capacity to achieve their objectives.

In short, this study aims to show a strategic alternative to generate value from the proposed relationships, promoting practices associated with knowledge creation and aligned with the context of the activities of the primary sector.

6.3. Limitations and future lines of research

Despite the above mentioned contributions, the present study has some limitations. First, the study was cross-sectional, not longitudinal. The data may be influenced by the subjectivity of the respondents, by their cultural and professional environment or level of formal education at a point in time. Therefore, it is proposed as a future line of research to incorporate measures at different moments of time to help validate the relationships raised in the model. Second, the developed model considers the knowledge management infrastructure as a construct made up of three variables. Faced with the particularities of the primary sector, other variables that help to explain a greater part of the knowledge creation variable should be considered as a future line of research. Human resources policy, and internal and external knowledge could be new variables to consider. Strengthening human resources management could foster relationships between internal collaborators to improve the work environment and communication, and in turn, collaboration with external collaborators as a source of knowledge acquisition could be expanded. A third limitation arises from having considered a single geographic area in the study. Consequently, as a future line of research, it is proposed to analyze the model proposed in other provinces of Ecuador and even in other countries, in order to establish differences in the processes of knowledge creation. As there are

no studies in the aquaculture sector, new studies could validate the findings found here and expand them.

Author contribution statement

Patrocinio Zaragoza-Sáez: Analyzed and interpreted the data; Contributed analysis tools or data; Wrote the paper.
Mayiya González-Illescas: Conceived and designed the analysis; Contributed analysis tools or data; Wrote the paper.

Data availability statement

The data that has been used is confidential.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e19536.

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