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Intellectual capital and sustainability in organizations of the Livestock Sector in Mexico

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Abstract

The aim of this research is to determine the relationship between intellectual capital and sustainability in organizations of the livestock sector of southern Sonora, Mexico. A quantitative methodology was used with a correlative-explanatory approach. The results of the study suggest the existence of a positive and significant correlation between the variables under study (r = .538; p <.001). Moreover, only human capital predicts sustainability by 38%. Finally, the results of this study for the livestock sector differ from the contributions of other authors, who claim that relational capital is the

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most significant component of intellectual capital in terms of sustainability.

Keywords: Correlation; Intellectual capital; Sustainability; Livestock; Mexico.

Capital intelectual y sostenibilidad en organizaciones del Sector Ganadero en México

Resumen

La presente investigación tiene como objetivo determinar la relación entre el capital intelectual y la sostenibilidad en organizaciones del sector ganadero del sur de Sonora, México. Para ello, se utilizó una metodología cuantitativa con un alcance correlativo-explicativo. Los resultados del estudio sugieren la existencia de una correlación positiva y significativa entre las variables en estudio (r = .538; p < .001). Asimismo, se obtuvo que solo el capital humano predice a la sustentabilidad con un 38%. Finalmente, los resultados de este estudio difieren de las contribuciones de otros autores, quienes afirman que el capital relacional es el componente del capital intelectual más significativo en términos de sostenibilidad.

Palabras clave: Correlación; Capital intelectual; Sostenibilidad; Ganadería; México.

1. INTRODUCTION

Sustainability is one of the most widely used terms at the global level because it is considered a paradigm from a visionary development that is generally used as an indicator that represents the search for participation, growth and improvement of the environment (Drexhage & Murphy, 2010). According to Lubchenco (1998), the concept of sustainability was created as a consequence of externalities and negative effects on the environment by human beings, in response to a planetary emergency (Vilches & Pérez, 2007). It should be noted that since the eighties, this concept has been studied and described by several authors, with a number of concepts arising (Stern, 1997). Subsequently, researchers have sought to synthesize, quantify and measure these concepts.

Currently, there is still no consensus about this concept (Glavic & Lukman, 2007), which is generally defined according to each context (Giddings, Hopwood, & O'Brien, 2002), in addition to acquiring a multifaceted and complicated meaning (Renukappa, Egbu, Akintoye, & Goulding, 2012). However, there are authors such as Goodland (1995), Pearce and Atkinson (1998), Drexhage and Murphy (2010), and Wasiluk (2013) who consider that the most popular and used definition of sustainability is that proposed by the World Commission on Environment and Development (WCED, p. 41) in 1987 - presided over by Harlem Brundtland - who defines this concept as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Likewise, it should be noted that several studies that analyze organizational sustainability from different perspectives and with different purposes have been performed; the perspectives include the following: (1) aiming to synthesize new strategic capabilities (Murthy, 2012); (2) proposing novel theoretical models to incorporate sustainability into commercial practices (Petrini & Pozzebon, 2010);

(3) identifying the strategies and practices that contribute the most to sustainability (Hart & Milstein, 2003); (4) suggesting methodological proposals for the design of sustainable processes (Dyllick & Hockerts, 2002); and (5) proposing measurement indicators for certain industries (Azapagic, 2003, 2004; Azapagic & Perdan, 2000; Krajnc & Glavic, 2003). It is important to mention that most of these studies seek to formulate economic, social and environmental strategies to later integrate them into organizational objectives as key success factors (Müller & Pfleger, 2014). Thus, when visualizing sustainability as an economic factor that generates value for an organization, authors such as Pearce and Atkinson (1998) and Solow (1993) consider it necessary to study the capacities and abilities of people because they claim that it is through natural, human and social capital that it is possible to obtain a balance in sustainability.

According to Wasiluk (2013), most models of organizational sustainability are based on the idea of managing and growing financial capital, being essential that organizations manage all their resources to boost growth (Benn, Dunphy, & Griffiths, 2014). To that end, it is necessary that they adequately manage their intangible resources (Kannan & Aulbur, 2004) because real value is represented by not only physical assets but also intangible assets (Brooking, 1997), these being the main assets that generate value (Stewart, 1998), in addition to being a potential source of differentiation (Perrini & Vurro, 2010).

Among the new paradigms for studying intangible assets, authors such as Reed, Lubatkin, and Srinivasan (2006) propose to investigate intellectual capital (IC) because it can be used as a creative source of value (Ramírez, 2007) when used as a management tool (Kaufmann & Schneider, 2004; Roos & Roos, 1997). In this regard, Edvinsson and Malone (1997) and Stewart (1994) agree on defining IC as the total of all intangible assets, knowledge and capabilities of a company, conformed by the dimensions of human capital, structural capital and relational capital (Bontis, 1999; Edvinsson, 1997; Sveiby, 1997).

Regarding the research about IC, their purposes have included the following: (1) finding a relationship with competitive advantages (Cleary & Quinn, 2016; Kamukama, 2013); (2) identifying the impact of this variable on organizational performance (Bontis, 1998; Bontis, Keow, & Richardson, 2000; Carmeli & Tishler, 2004; Sharabati, Jawad, & Bontis, 2010) and (3) estimating the mediating effect between competitive advantages and other factors, such as financial performance (Kamukama, Ahiauzu & Ntayi, 2011). However, despite the fact that intellectual capital has been used many times to determine its organizational value or to identify competitive advantages (Stewart, 1994), other explanatory factors have sometimes been left out, such as the implementation of sustainable practices (Claver-Cortés, López-Gamero, Molina-Azorín, & Zaragoza-Sáez, 2007). For this reason, there is a knowledge gap in which the relationship between intellectual capital and sustainability should be addressed.

In this regard, it should be noted that previous research has focused on qualitatively studying the manner in which intellectual capital influences environmental management practices (López-Gamero, Zaragoza-Sáez, Claver-Cortés, & Molina-Azorín, 2011; Wasiluk, 2013), seeking to identify actions that benefit the environment but without demonstrating their relationship or causality. Based on the foregoing, this research proposes the following two objectives: (1) to determine the relationship between the variables intellectual capital and sustainability in organizations of the livestock sector of southern Sonora, also considering the possible association between each of their dimensions and (2) to determine which dimension(s) of intellectual capital explain the variable sustainability (see Figure 1 below). It should be noted that despite the fact that the livestock sector is considered an important economic driver of the country (Sada & Moreno-Casola, 2008), the knowledge that exists about its management and environmental care is practically non-existent in the national and international academic literature.

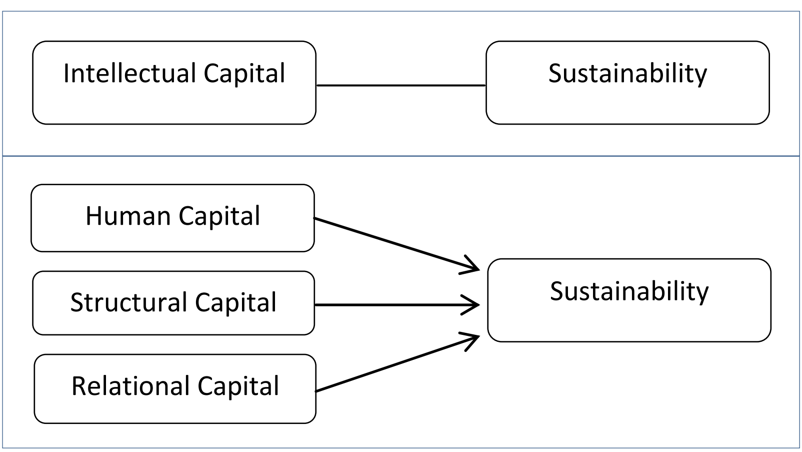

Figure 1. Empirical model of the study. Prepared by the authors

In consideration of the empirical model illustrated above, which arises from models that suggest a positive association between the dimensions of both variables (Adams, 2015; Makarov, 2010; Wasiluk, 2013), including studies that propose explain environmental management through the dimensions of intellectual capital (e.g. López-Gamero et al., 2011); the hypotheses of the present investigation are presented below:

H_1: There is a positive and significant relationship between the variables and dimensions of intellectual capital and sustainability in organizations of the livestock sector of southern Sonora.

H_2: The dimensions of human, structural and relational capital predict in a significant manner the variable sustainability in organizations of the livestock sector of southern Sonora.

2. LITERATURE REVIEW

2.1. Theory of resources and capabilities

Intangible resources are considered one of the main assets that generate a potential source of differentiation (Perrini & Vurro, 2010), as well as value for the organization (Stewart, 1998). This approach has been addressed theoretically from the theory of resources and capabilities (*Resource Based View),* which has been used for the purpose of explaining, analyzing and understanding the situation that exists in organizations (Powell, 2001) by classifying tangible and intangible assets of all those resources and capabilities that companies possess. According to Newbert (2007), this theoretical approach is considered useful in the field of strategic management due to its analysis of assets that can be considered a strength or weakness for the organization (Wernerfelt, 1984).

On the other hand, other authors, such as Grant (1991) and Conner and Prahalad (1996), consider tangible and intangible assets as the central axis orienting an organization. This approach argues that companies develop a sustainable competitive advantage through the design of strategies that allow them to convert their resources and capacities into rare, valuable, inimitable and irreplaceable assets (Barney, 1991).

It should be noted that this theory, focusing mainly on the internal resources of the organization, does not consider the business environment of organizations (Porter, 1999) or the creation of new strategies or resources (Foss, 1997). However, authors such as Hart (1995) propose as an opportunity for companies to adopt environmental strategies, which, as a result, generate resources and capacities that are difficult for competitors to imitate, thus achieving certain sustainability due to their positive economic and social impacts (Chan, 2005).

Reed et al. (2006) indicate certain ambiguity in the theory of resources and capacities, because the *competitive advantage* concept doesn't clarify connotations; for this reason, these authors provide a new paradigm in the use of intellectual capital.

2.2. Intellectual capital

Among the various authors who have studied IC, one of the most recognized is Stewart (1997), who defines this construct as intellectual material - knowledge, information, experience, and intellectual property - that can be exploited for the purpose of generating wealth. For their part, Mouritsen (1998) and Edvinsson and Malone (1997) similarly define IC as the total of all the intangible assets, knowledge and capabilities of a company that can create value or competitive advantages to achieve the company's goals. Finally, Bontis (1996) defines IC as the difference between the replacement cost of assets and the market value of the organization.

In consideration of the numerous definitions of IC that exist, several authors, such as Bontis (1996), Brooking (1997), Research Center on the Knowledge Society ([CIC], 2003), Edvinsson (1997), Stewart (1998), Sveiby (1997) and Johnson (1999), propose only three dimensions to analyze IC; these dimensions, together with their respective definitions, can be observed in the following Table 1.

Table 1. Definitions of the dimensions of intellectual capital

Author (s)	Human capital	Structural Capital	Relational Capital
Sveiby (1997)	They are the competences that arise through aspects such as skills, experiences, values and education.	It refers to the internal structure of the organization, such as culture, internal networks, informal organization, administrative and computer systems.	It is found in the internal structure and in all relationships with customers, suppliers, brands and reputation.
Brooking (1997)	Are the assets related to the individual, which focus on expertise, ability to solve problems, creativity, leadership and the ability to manage.	The author classifies it as infrastructure and intellectual property assets. The first is related to the assets of the organization and the second to the technological ones.	They are market assets, related to brands, franchises, distribution channels and licenses.
Edvinsson (1997)	It is a human approach that considers the knowledge, leadership and motivation of people.	It is a process approach that in turn involves information technologies.	It is a client approach that refers to the relationships that the organization has with them.
CIC (2003)	Represents the value of knowledge such as the talent that each person has, and these can be represented by values, attitudes, skills and	Represents the value of existing knowledge that is owned by the organization, subdivided into organizational and technological capital.	It represents the value of the knowledge incorporated in people and the organization, whose main objective is relationships,

	abilities of each individual	with these being business or social.

Note. Prepared by the authors.

2.3. Sustainability

It should be noted that due to its dependence on each context, the concept of sustainability is usually multifaceted and complicated (Giddings et al., 2002; Renukappa et al., 2012), and there is still great controversy about the terms used to refer to sustainability. Despite these discussions, one of the definitions most used today (e.g. Drexhage & Murphy, 2010; Goodland, 1995; Wasiluk, 2013) is that of the WCED (1987, p. 41), who defines this concept as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*" Other authors, such as Elkington (1997), define sustainability as the search for harmony between the environment and financial aspects, in addition to social and ethical aspects. Similarly, according to Leff (2002), sustainability implies the exploitation of resources in a rational and balanced manner to reduce possible deterioration. The above can be observed in its terminology from the Latin "*sustineire,*" which means to sustain, maintain or support (Luffiego & Rabadán, 2000).

Sustainability can be understood as a paradigm for thinking about a future in which environmental, social and economic considerations are balanced in the pursuit of development and a better quality of life (Mckeown et al., 2002)

Regarding this variable, the taxonomy most used today to classify the dimensions of sustainability is the proposal of the *Triple Bottom Line* (TBL) of Elkington (1997). According to this author, this conceptual model is integrated by the following dimensions: (1) *economic*, which seeks to make the organization profitable and generate benefits for its investors; (2) *environmental,* a dimension that seeks to diminish the negative impacts on the surroundings or environment; and (3) *social*, where it is proposed to maximize the use of resources to benefit the main stakeholders or interested parties (see Figure 2).

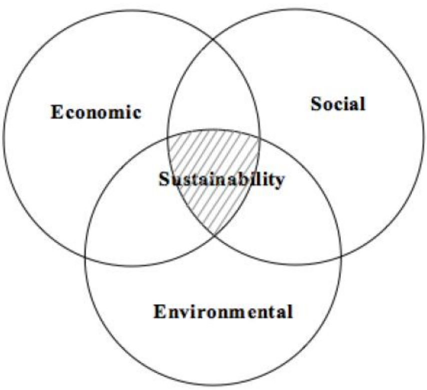

Figure 2. Dimensions of sustainability. Prepared by the authors based on the theoretical proposal of "*Cannibals with Folks: The Triple Bottom Line of 21st Century Business*", by J. Elkington, 1997, London, United Kingdom: Capstone, Oxford, pp.69-96. Copyright 1997 by John Elkington.

2.4. Empirical studies regarding intellectual capital and sustainability

The literature review of the concepts, intellectual capital and sustainability, suggest that they can be classified in three different types. First are all those contributions that mention the green intellectual capital (GIC) construct proposed by Chen (2008, p. 277), who defines it as "the total of intangible assets, knowledge, skills, relationships, among others, focused on environmental protection or green innovation at an individual and organizational level;" in addition to this theoretical contribution, this author makes an empirical verification of the relationship of GIC with competitive advantages in 126 manufacturing companies in Taiwan. In this same category is the study by Huang and Kung (2011), who analyze the environmental consequences and their relationship with the management of GIC, in addition to its impact on competitive advantage. Finally, it is worth mentioning the contribution of Delgado-Verde, Amores-Salvadó, Martín-Castro, and Navas-López (2014), who explore the relationship between GIC and the innovation of some environmental products.

A second category of research studies includes those that study IC and corporate social responsibility (CSR), such as Lungu, Caraiani, and Dascalu (2012), who propose a theoretical model to promote the integration of the components of IC and CSR from a new perspective called sustainable IC. There is also the study by Chang and Chen (2012), whose objective was to explore the influence of CSR on GIC. Finally, the study by Martínez and Rodríguez (2013), who analyze the possible relationship between relational capital - one of the dimensions of IC -, sustainability and corporate reputation of companies, should be mentioned.

The third group of studies focuses on knowing the relationship between IC and sustainability, where authors such as López-Gamero et al. (2011) studied eight companies from the three economic sectors, concluding that an organizational design should consider environmental actions and their impacts. In this sense, the authors consider that sustainable intellectual capital helps to overcome the deficiencies of conventional approaches to environmental management systems. On the other hand, Wasiluk (2013) conducted a qualitative study of four Australian companies, where he used the information available about IC and sought to relate it to corporate sustainability; the research concludes that human capital allows sustainable practices to be implemented to achieve corporate efficiency, and the author proposes the inclusion of programs that encourage the development of knowledge and skills from approaches related to corporate sustainability. It should be noted that both investigations analyze companies that currently have some environmental certification or use practices of environmental protection.

3. METHOD

The present investigation used a quantitative methodology, through a non-experimental cross-sectional design (Briones, 2003;

Hernández, Fernández, & Baptista, 2014). The scope of the study was correlative-explanatory because the objective of the research was to determine the relationship between IC and sustainability, in addition to determining which of the IC dimensions predict sustainability (Creswell, 2014).

3.1. Participating subjects

The study population was all those people dedicated to livestock who belonged to the local livestock associations of the municipalities of southern Sonora, representing a population of 1,704 ranchers. For the determination of the sample, a non-probabilistic convenience method was used, using the chain or snowball technique (Creswell, 2014), with which the total participation of n = 72 farmers was finally obtained. According to Abranovic (1997) and Anderson, Sweeney, Williams, Camm, and Cochran (2014), it is possible to carry out reliable statistical tests with a minimum sample size of 50 subjects, as long as the specific requirements are met.

Among the main characteristics of the subjects who participated in the study is an average age of 59.9 years, with a standard deviation of 15.4 years; in addition, the ages varied within a range of 71 years, from 19 to 90 years of age. Likewise, of the total sample, 63 (87.5%) participants were men, and only 9 (12.5%) were women. The age of the companies to which these subjects belonged was of an average of

25.1 years, whereas the average number of cattle heads of these organizations was 141.5 units of cattle standing - including cows, young calves and bulls. Finally, it was possible to identify that 65.3% (47 ranchers) were engaged in some other productive activity in addition to livestock; the four most recurrent activities were as follows: 32 (44.4%) people indicated being farmers; 6 (8.4%) people mentioned serving as administrators of an organization; 3 (4.2%) people said they dedicate themselves to the commercialization (purchase and sale) of grains and cattle; and finally another 3 (4.2%) people indicated offering their services as veterinarians. Table 2 presents other additional characteristics of the farmers that participated in the investigation.

Table 2. Characteristics of the subjects participating in the study (N = 72)

Characteristics	N	%
Cattle		
Meat	23	31.9
Milk	14	19.4
Double purpose	35	48.7
Productive Activity		
Breeder	35	48.6
Producer	13	18.1
Fattening	5	6.9
Exporter	2	2.8
Others*	17	23.6
Municipality to which it belongs		
San Ignacio Río Muerto	24	33.3
Cajeme	16	22.2
Quiriego	10	13.9
Álamos	5	6.9
Bácum	5	6.9

Navojoa	4	5.6
Guaymas	3	4.2
Rosario Tesopaco	3	4.2
Benito Juárez	1	1.4
Etchojoa	1	2.4
Schooling		
Primary	15	20.8
Middle school	9	12.5
High school	9	12.5
University	26	36.1
Postgraduate	6	8.3
None	7	9.7

Note. Prepared by the authors with the information from the sample. * Subjects that are engaged in more than one productive activity.

3.2. Measuring instrument

To be able to measure the variables under study and each of its dimensions, a questionnaire that comprised a total of seven sections, for which some theoretical proposals and indicators of various authors were considered, was designed and elaborated (see the following Table 3). The first section corresponds to the sociodemographic data about the participating subjects (e.g., age, sex, and schooling), whereas the remaining six sections refer to each of the dimensions of IC (human [6 items], structural [6 items] and relational [6 items] capital) and sustainability (economic [5 items], social [5 items] and environmental [5 items] dimensions), which in total composed an instrument of 33 questions.

Table 3. Characteristics and operationalization of the variables of the measuring instrument

	Dimension	Indicator	No. of elements	Items
Intellectual capital	Human capital	Knowledge. - (Bueno, 1998; CIC, 2003; Dzinkowski, 2000; Sharabati et al., 2010)	3	1-3
		Expertise. - (CIC, 2003; Dzinkowski, 2000; Sveiby, 1997)	2	4,5
		Creation. - (CIC, 2003; Sharabati et al., 2010)	1	6
	Structural capital	Organizational capital. - (CIC, 2003; Bueno, 1998)	3	7-9
		Technological capital. - (CIC, 2003; Bueno, 1998)	3	10-12
	Relational capital	Suppliers. - (Bontis, 1998; Bueno, 1998; Bueno et al., 2004; CIC, 2003; Joia, 2004; Ordóñez, 2004; Sveiby, 1997)	2	13-15
		Clients. - (Bontis, 1998; Brooking, 1997; Dzinkowski, 2000; Edvinsson, 1997; Edvinsson & Malone, 1997; Johnson, 1999; Sveiby, 1997)	4	16-18
Sustainability	Economic	Financial. - (Azapagic, 2003, 2004; Azapagic & Perdan, 2000; Cetinkaya et al., 2011; Krajnc & Glavic, 2003)	3	19-21
		Administration of personnel. - (Azapagic, 2003, 2004; Azapagic &	2	22,23

	Perdan, 2000; Krajnc & Glavic, 2003)		
Environmental	Conservation. - (Closs et al., 2011)	2	24,25
	Use / Reduction. - (Azapagic & Perdan, 2000; Closs et al., 2011; Krajnc & Glavic, 2003)	1	26
	Business practices. - (Closs et al., 2011)	2	27,28
Social	Ethics. - (Azapagic & Perdan, 2000; Carroll, 1979; Cetinkaya et al., 2011; Closs et al., 2011; Williams & Monge, 2001)	2	29,30
	Wellbeing. - (Azapagic, 2003, 2004; Azapagic & Perdan, 2000; Wulfson, 2001)	3	31-33

Note. Prepared by the authors.

To answer all these questions, a Likert scale with five response options ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*) was used, where a higher score was considered an indication of a higher level of agreement with each of the stated statements. It should be noted that all the questions were written in a positive sense to avoid possible problems in their understanding, and not control questions were included in the survey.

For the purposes of this instrument, IC is understood as the sum of knowledge, skills and abilities - either individual or collective - that are owned by human capital and not by the organization, in addition to the set of information, processes, technologies and intellectual property that are owned by the organization (structural capital) and the relations with customers, suppliers, shareholders and society in general that provide value to the organization (relational capital) (Brooking, 1997; CIC, 2003; Edvinsson, 1997; Sveiby, 1997). Sustainability was defined as actions that consist of satisfying current needs without compromising future generations, adding that the actions performed by the organization must be economically viable, socially responsible and environmentally sustainable (Azapagic, 2003, 2004; Azapagic & Perdan, 2000; Drexhage & Murphy, 2010; Elkington, 1997; Krajnc & Glavic, 2003).

3.2.1. Validity and reliability of the instrument

The questionnaire was validated through the opinion of three researchers specialized in the study of IC and sustainability (content validity); for this reason, their support was requested in the review and assessment of each dimension and question of the questionnaire, with the purpose of identifying any ambiguity in the words or sentences, in addition to the clarity and meaning of the instrument. Subsequently, the factorial structure of the instrument was verified (construct validity), for which an exploratory factorial analysis was carried out through the principal components method of extraction and a varimax rotation. The results showed a Kaiser-Meyer-Olkin (KMO) index of .732, a determinant of 2.66×10^{-6}, a significant Bartlett's test of sphericity (X^2 = 806.494; *gl* = 231; *p* <.001), and factorial loads greater than .40 in all items. The foregoing suggests the suitability of the analysis model for this type of data, although a larger sample size is recommended (*n* <200 [Hair, Anderson, Tatham, & Black, 2010; Pett, Lackey, & Sullivan, 2003]).

Furthermore, taking the Kaiser-Guttman criterion (Eigenvalues > 1) for the inclusion of factors in the factorial structure (Field, 2018), is that a solution constituted by six factors was obtained - explaining a 70.6% of the variance of the total scores of the measuring instrument -. The first factor (environmental dimension) was integrated by four items (numbers: 25, 26, 27 and 28) explaining 29.95% of the variance, the second factor (relational capital) was formed of six items (numbers: 13, 14, 15, 16, 17 and 18) with 15.19% of the variance, the third factor (human capital) was composed of four items (numbers: 1, 2, 3 and 4) with a 9.14%, the fourth factor (structural capital) was constituted by only two items (numbers: 10 and 11) with a 7.48%, and finally the factors fifth (economic dimension) and sixth (social dimension) were integrated by three items each, explaining the 6.49% (numbers: 19, 20 and 21) and 5.35% (numbers: 31, 32 and 33) respectively (see Table 4). It is worth mentioning that 11 items were eliminated because they generated confusion in the factorial structure, presenting similar loads and communalities below .30 (See Table 5 for all questions).

Table 4. Summary of items and factorial loads of the exploratory factor analysis (n = 72)

Items	Cargas factoriales						
	1	2	3	4	5	6	h^2
Item 28	**0.85**	-0.06	0.25	0.00	0.07	-0.01	.80
Item 26	**0.80**	-0.10	0.12	-0.12	0.00	0.11	.68
Item 25	**0.75**	0.07	-0.01	0.20	0.16	0.17	.66
Item 27	**0.69**	0.09	0.28	0.31	0.15	0.03	.67
Item 16	-0.08	**0.85**	-0.19	0.27	0.04	-0.08	.84
Item 17	0.10	**0.84**	0.00	-0.13	-0.15	0.20	.79
Item 18	-0.02	**0.75**	0.08	-0.37	0.10	0.01	.72
Item 14	0.00	**0.59**	-0.05	0.38	0.18	0.07	.54
Item 13	0.20	**0.56**	0.15	0.31	0.30	-0.08	.56
Item 15	-0.26	**0.55**	0.03	0.34	0.14	0.10	.51
Item 2	0.04	-0.10	**0.84**	0.09	-0.09	0.13	.75
Item 4	0.23	0.10	**0.75**	0.13	0.23	0.09	.70
Item 3	0.31	-0.03	**0.64**	0.27	0.31	0.05	.68
Item 1	0.31	0.01	**0.43**	-0.09	0.22	0.23	.40
Item 11	0.10	0.08	0.05	**0.83**	0.07	0.10	.72
Item 10	0.10	0.13	0.29	**0.81**	0.03	-0.04	.77
Item 19	-0.09	0.15	0.00	-0.05	**0.87**	0.09	.80
Item 21	0.39	0.04	0.28	0.09	**0.75**	0.06	.81
Item 20	0.34	0.10	0.26	0.30	**0.67**	0.12	.74
Item 32	0.11	0.03	0.09	0.08	-0.01	**0.91**	.85
Item 31	-0.01	0.17	0.08	-0.04	0.09	**0.90**	.85
Item 33	0.34	-0.10	0.30	0.11	0.27	**0.63**	.69

Note. Bold numbers indicate the highest factor loads. h^2= communality.

Regarding the reliability of the instrument in general and of each of the dimensions under study, all of reliabilities were obtained using the Cronbach alpha coefficient (α). This coefficient obtained a value of α = .854 for the entire measurement instrument, whereas the IC was .750 for human capital, .795 for structural capital and .807 for relational capital, in addition to .797 for the economic dimension, .829 for the environmental dimension and .820 for the social dimension of sustainability. All the previous coefficients were considered desirable and acceptable (Hair et al., 2010; Martínez et al., 2006).

Table 5. Questions of the measurement instrument

Items	Our organization...
Item 1	It gives its employees courses and/or workshops in a constant way that allows them to expand their knowledge and skills to do their job.
Item 2	It encourages the search for learning of its workers, to improve the activities they perform.
Item 3	Seeks the personal growth of their workers, which allows them to generate skills and/or expertise to carry out their activities.
Item 4	It encourages its employees to share their knowledge, experience and skills with each other.
Item 5	It has employees who demonstrate to have the necessary skills to perform their work and/or activities.
Item 6	It has employees with the necessary capacities to carry out their activities, so that they achieve the expected results.
Item 7	It has a set of beliefs, habits, attitudes, traditions that guide the organization.
Item 8	It has the physical conditions and the necessary equipment to carry out its activities in an efficient way.
Item 9	It has a process defined to carry out the daily activities.
Item 10	Our company makes use of a control system that registers the productivity of the organization.
Item 11	Takes a control of the activities of their employees, to supervise their performance.
Item 12	Design new procedures that allow you to perform their work in an optimal way.
Item 13	Know all the products and services that offer their suppliers.
Item 14	It has suppliers that always comply with the requested.
Item 15	Is concerned to meet the needs of its customers, to give you the best product and/or service.

Item 16	Has a long-term relationship with its customers, which allows it to have loyal customers.
Item 17	Has a close relationship with its customers, to carry out their activities without any setbacks.
Item 18	Has direct communication with its customers, which allows you to get to know their needs.
Item 19	Has maintained its sales high enough to compete in the market.
Item 20	Has production processes that allow you to be more profitable.
Item 21	Has increased its production capacity with the same resources.
Item 22	Invests in programs of health and safety for employees.
Item 23	Invests in programs such as incentives, prizes, bonuses, among others, for the development of its employees.
Item 24	Adopts alternatives for the reduction of energy consumption and/or water, which allow you to maintain the ecological balance.
Item 25	Is involved in programs for the protection of the environment, that allow you to conserve natural resources.
Item 26	Adopts alternatives for the reduction of greenhouse gas emissions, to decrease the harmful impact on the ozone layer.
Item 27	Uses environmentally friendly technology, that allows you to improve and/or facilitate the practices that performs.
Item 28	Reduces the use of chemicals and/or hazardous materials, to decrease the impact to the environment.
Item 29	Operates in accordance with the ethical standards of the members of the society, to maintain a harmonious relationship with the community
Item 30	Gives fair prices to their customers, where their needs are met without compromising the quality of the product.
Item 31	Collaborates in social and/or community activities that benefit the society.
Item 32	Participates in activities that improve the quality of life of the community, such as the restoration of green areas, schools, parks, among others.
Item 33	Promotes the volunteer work of its workers, supporting philanthropic actions that benefit the society.

Note. Prepared by the authors

3.3. Procedure

Once the instrument was designed and developed, it was applied during the period from February to June 2017. The average response time was 30 minutes, extending longer to respond on occasions when the participants explained or supported some of their answers.

Once the data were collected, all the information was compiled and captured in a database through the SPSS statistical software package (version 22). This program was used to perform statistical analyses (e.g., normality, linearity, homoscedasticity, independence of errors, Pearson correlation [r], and linear regression [R^2]) and the corresponding reliability tests (α). Once the results of the tests were obtained, we proceeded to the preparation of this research report.

4. RESULTS

As part of the statistical analysis to answer the research objective that consists of determining the relationship between the intellectual capital and sustainability variables, in addition to each of its dimensions, *Pearson's* bivariate parametric test was used because data distribution was normal (Ho, 2006). This correlation coefficient determines the direction and magnitude of the relationship between the two variables, ranging from -1.0 (perfect negative association) to 1.0 (perfect positive association [Williams & Monge, 2001]), whereas values close to 0.0 represent a virtually non-existent relationship (Cronk, 2017).

As a first finding, a positive and significant correlation was identified (*r* = .538; *p* <.001) between the variables intellectual capital and sustainability, exhibiting a high effect magnitude (Field, 2018). Likewise, the following are the significant associations that resulted from each of the dimensions of the variables, with the dimensions with the greatest effect size being the following: human capital and the environmental (*r* =.523; *p* <.001) as well as the economic dimension of sustainability (*r* =.493; *p* <.001 [see Table 6]).

Table 6. Correlation coefficients between the variables intellectual capital and sustainability (n = 72)

No.	Dimensions	M	DS	1	2	3	4	5	6
1	Human capital	3.451	1.047	-					
2	Structural capital	3.305	1.476	.326**	-				
3	Relational capital	4.294	0.770	.059	.301*	-			
4	Economic	3.180	1.308	.493**	.265*	.276*	-		
5	Environmental	1.909	1.198	.523**	.254*	.076	.431**	-	
6	Social	2.782	1.486	.381**	.144	.117	.312**	.300*	-

* *p* < .05; ***p* < .01 (two-tailed).

Subsequently, a linear regression analysis was performed to determine which dimension(s) of intellectual capital drives sustainability. Table 7 presents the results, identifying that only human capital is the dimension that positively and significantly predict sustainability, with a total explained variance of 38%.

Table 7. Summary of the linear regression analysis for the intellectual capital dimensions as predictors of sustainability

Variable	B	SE B	β	t	p
Human capital	0.59	0.09	.62	6.60	.000

Note. R^2 = 38.4 (N = 72, p < .001).

In consideration of the previous results that suggest an association between the variables and the dimensions of IC and sustainability, this finding coincides with the results of López-Gamero et al. (2011) and Wasiluk (2013), who also provide evidence for this relationship, mainly with the environmental and economic dimensions of sustainability. In addition to the above, authors such as Chang and Chen (2012) and Huang and Kung (2011) note that intellectual capital and its dimensions are positively associated with the environmental dimension. It should be noted that these authors have considered sustainability as a unified concept of IC, which is characterized for being "the sum of all knowledge that an organization is able to leverage in the process of conducting environmental management to gain competitive advantage" (López-Gamero et al., 2011, p.19), to which specially they propose to include the environmental indicators to the relational capital (CIC, 2003; Claver-Cortés et al., 2007).

Moreover, it could be identified that the dimension of human capital is shown as a variable that explains the sustainability in the livestock sector, which could be explained that human capital has a great potential to contribute to the strategies (Sullivan, 2000), in addition to people being the means and causes contributing to social development and economic growth (Šlaus & Jacobs, 2011), this through the appropriate use of the skills and abilities they possess to generate a balance in sustainability (Pearce & Atkinson, 1998; Solow, 1993). It is also important to stress that human capital may have such a predictive value for sustainability because this dimension is the basis for the development of other capital, in addition to other intangible variables (Madrigal, 2009).

It should be noted that although relational and structural capital exhibited a relationship with sustainability, it was not possible to find any degree of predictability for these dimensions on the dependent variable. This result disagrees with the report by Arshad, Ab Samad, Kamaluddin, and Roslan (2016), who point out that structural capital is the main dimension or predictor factor in the creation of value with respect to sustainability actions. In addition, the results of this study differ from the contributions of Martínez and Rodríguez (2013), Adams (2015), and Chen (2008), who claim that relational capital is the most significant component of IC in terms of sustainability.

5. CONCLUSION

The objectives of the present investigation were to determine the relationship between the variables and the dimensions of intellectual capital and sustainability; in addition to discover which dimensions of intellectual capital explain sustainability. The results suggest the existence of a significant and positive association between intellectual capital and sustainability, thus proving the first hypothesis of this study. On the other hand, the structural and human capital are more associated with the economic and environmental dimensions, whereas the relational capital only associates with the economic dimension of sustainability. It was also possible to identify that human capital is a predictive element of sustainability in the livestock organizations of southern Sonora, being able to partially verify the second hypothesis of the present investigation.

As a contribution of the present investigation, it is worth noting that for this purpose, the measurement instrument had to be designed and developed as a result of an extensive literature review, whose reliability coefficients were within the parameters of desirability and acceptability – which was validated by exploratory factor analysis -. Having an instrument to quantify these variables will surely allow us to continue analyzing the relationship and influence of intellectual capital and sustainability in various sectors and through broader samples. It is very possible that the information obtained from future research will help organizations of this sector to create strategies or design procedures that help maximize the use of their intangible assets (e.g., IC) for its benefit, in addition to implementing sustainable practices.

Future research should consider what Elkington (1997) proposed in his book *Cannibals with Forks*, which consists of measuring sustainability through the *Triple Bottom Line* model, in which the economic dimension is not measured in relation to tangible assets or monetary performance but, rather, IC is used as a tool to assess the value of organizations in the current knowledge society (Drucker, 1969). It is also recommended to analyze how IC and sustainability are related to the generation of competitive advantages (Huang & Kung, 2011; Kamukama, 2013; Stewart, 1994) or performance (Bontis, 1998) because literature supporting both variables will help organizations achieve greater economic growth (Adams, 2015; Wasiluk, 2013) or differentiating value (Guerrero-Baena et al., 2015; Lungu et al., 2012).

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