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## MANAGERIAL MANAGEMENT FACTORS THAT AFFECT THE INNOVATION OF AGRICULTURAL MSMEs IN THE NORTH OF SANTANDER, COLOMBIA

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**Abstract.** A main problem in agricultural MSMEs is the deficiency in managerial management and innovation. This situation allows us to establish as an objective of the study to analyze the factors associated with managerial management deficiencies that affect innovation in agricultural MSMEs in Norte de Santander. The level of research is correlational; it was carried out between the years 2020-2022. To this end, a quantitative approach was used. The data collection instruments were applied to fifty (50) agricultural producers, owners, managers or sideman's in the farms of Rice, Coffee, and *Piaractus brachypomus* and *Oreochromis sp.*, in Norte de Santander. The results determine a direct and significant correlation between the lack of competence of managers and the lack of articulation with the public sector as factors that affect innovation in agricultural MSMEs ( $p < 0.05$ ). Likewise, a positive correlation was evidenced between the lack of managerial skills and the lack of articulation with the private sector, the lack of technology transfers and knowledge management, as factors that affect innovation in agricultural MSMEs ( $p < 0.05$ ). There is also a positive and significant correlation between the lack of technology transfer and knowledge management, as determining factors of little innovation ( $p < 0.05$ ). It is concluded that there is a deficiency in agricultural management that limits innovation in agricultural MSMEs in Norte de Santander.

**Keywords:** Management, agricultural MSMEs, competitiveness, innovation.

## FACTORES DE GESTIÓN GERENCIAL QUE AFECTAN LA INNOVACIÓN EN LAS MIPYMES AGROPECUARIAS DEL NORTE DE SANTANDER DE COLOMBIA

**Resumen.** Un problema principal en las MIPYMES agropecuarias, es la deficiencia en la gestión gerencial y la innovación esta situación permite establecer como objetivo del estudio analizar los factores asociados a las deficiencias de gestión gerencial que afectan la innovación las MIPYMES agropecuarias del Norte de Santander. El nivel de investigación es correlacional, se realizó entre los años 2020-2022. A tal fin se utilizó un enfoque cuantitativo. Los instrumentos de recolección de datos se aplicaron a cincuenta (50) productores agropecuarios

propietarios, gerentes o mayordomos en las fincas de Arroz, Café, y *Piaractus brachyomus* y *Oreochromis* sp., del Norte de Santander. Los resultados determinan correlación directa y significativa entre la falta de competencia de los gerentes y la falta de articulación con el sector público como factores que afectan la innovación en las MIPYMES agropecuarias ( $p < 0.05$ ). Igualmente se evidenció correlación positiva entre la falta de competencias de los gerentes y la falta de articulación con el sector privado, la falta de transferencia tecnológica y gestión del conocimiento, como factores que afectan la innovación en las MIPYMES agropecuarias ( $p < 0.05$ ). También hay correlación positiva y significativa entre la falta de transferencia tecnológica y gestión del conocimiento, como factores determinantes de la poca innovación ( $p < 0.05$ ). Se concluye que existe deficiencia en la gestión agropecuaria que limita la innovación en las MIPYMES agropecuarias del Norte de Santander.

**Palabras clave:** *Gestión gerencial, MIPYMES agropecuarias, competitividad, innovación.*

## Introduction

In this regard, Gibson, Brenes and Barahona (2011) comment that innovation goes beyond laboratories and must include new management practices. Likewise, Plaza and Blanco (2015) point out that agricultural MSMEs, face high deficiencies in administrative organization, are not managed as companies but as a family estate, with low competitiveness and innovation, with little use of technologies, factors that limit their possibilities of staying in the market. Therefore, the GG in agricultural MSMEs, must innovate in their management practices to improve the productivity and sustainability of MSMEs, as a fundamental sector in the contribution to the Gross Domestic Product (GDP), according to Asobancaria (2018) they contribute approximately between 41% and 81% to the GDP favoring formal jobs, the multiplicity of services to favor innovation and competitiveness.

In this sense, Silva (2021) and Chesbrough (2020) emphasize that the contingency approach to which these companies are accustomed contrasts with situations that do not allow improvisation and put the organization at risk of extinction, such as what is currently posed by the pandemic scenario generated by Covid19, therefore, therefore, they suggest that open innovation should be strengthened in order to increase the probabilities of success by establishing collaborative relationships with other organizations when seeking to innovate, since in this way new knowledge is accessed, which allows the evolution of new strategies suitable for responding to the turbulent conditions that exist in the environment.

In this context, other authors such as García (2017), Asobancaria (2018), Mora (2012) agree on the need to transform the GG of agricultural MSMEs, in such a way, that they contribute to overcome their innovation and survival problems, leave aside the contingency approach and implement alternatives of new management tools, articulation with the environment and open innovation. They must overcome the empirical management used by their owners and proprietors, without paying attention to the scientific and technical foundations of management and the empowerment of workers, stop making personal decisions, without considering the different factors of production, the context, give due importance to knowledge management, the training of human talent, include innovation among the priorities of the owners or managers of MSMEs, disinterest in each of these variables limits the possibilities of innovation and therefore their possibilities of growth and development.

Another aspect that affects the shortcomings in the GG of these companies is that academia has not sufficiently addressed this issue, it is necessary to know the different concerns of stakeholders and reflect, from different perspectives, from universities, governments and entrepreneurs themselves, although there is articulation between these actors formally, in practice it is deficient. Also, Mora (2012), Finca y Campo (2015), and Chong (2012) highlight the lack of knowledge about agricultural management tools, the low adoption of technology,

innovation and low competitiveness, among others, factors that limit the GG, in the generality of the Colombian Rural Areas. Consequently, one of the problems of agricultural MSMEs is the underdevelopment of the management factor and, consequently, their development and innovation. This situation of deficiency in management management limits the use of the potential and opportunities for innovation of the Agricultural Production Units (UPA).

Among the antecedents on this problem in the international context, Camacho (2018), conducted an analysis in Mexico of the managerial profile of managers in farms in which he determined the need to improve written and strategic communication skills, teamwork competence, interpersonal skills, organizational knowledge, and talent development. Meanwhile, Hernandez, Hernandez, Perdomo, Garces, and Carrasco (2018) identified the need to improve the training of actors in farming, knowledge management. Egas, Shik, Inurritegui and De Salvo (2018), explain that agricultural policy, should be oriented to reduce market price support and favor interventions that have a lower impact on market distortion. Other studies such as those of García (2017), Milagros (2015), and Chong (2012) among the various problems of the UPAs, the deficiency of financial management, migration to the urban world generating the rupture of the social fabric, there is a need to integrate the public, private and academic sectors, which support public management and business management in line with the requirements of innovation, dynamics and reality of agricultural MSMEs.

In the National context, authors such as Villanueva (2018), Corporación Colombiana de Investigación Agropecuaria (2016), Melo and Fonseca (2014), Castaño and Cardona (2014), García, Malagón and García (2017), point out among the problems of the UPAs, are barriers to innovation in the bioeconomy due to low levels of technology maturity and not complying with national and international standards, these are at level TRL3 and TRL4, therefore, they require levels TRL5, TRL6, TRL7, TRL8, and TRL9; lack of evidence to determine the degree of progress and development in Knowledge Management (KM), in the context of KM in networks, tacit knowledge predominates over explicit knowledge, contrary to the essence of KM and organizational learning; lack of strengthening in strategic and operational planning, KM and innovation; low productivity and high production costs, limiting competitiveness.

In the regional context, Cala (2019), García, Malagón and García (2017) highlight the need for owners or managers to emphasize quality management and environmental management, they also point out the deficiencies in business management and the need to develop new competencies of human talent, carry out technology and knowledge transfer, improve knowledge management, and there is little capacity to adapt to the dynamics of changes in agricultural MSMEs.

In the approach to the object of study of business management (MB), the different definitions of MB, Project Management, related disciplines, main related theories, scientific disciplines involved, innovation management and national, departmental and municipal development plans were considered.

Regarding the definition of GE there are diversity of definitions, however, there is coincidence among some authors such as Guzman (2016), Franco, Zartha, Solleiro, Montes, Vargas, Palacio, and Hoyos (2018), Suarez (2018) and Terrazas (2009), Hernandez (2011) point out that GE is based on the most important information to exist and prosper, every organization has to become an agent of change and technology will be the main agent for economic change. They also specify that the GE refers to the elements, measures, strategies and skills used in an economic or business activity to make it financially viable. For this to be possible, four functions must be fulfilled: (a) planning, (b) organization, (c) direction, management and leadership, and (d) control. In the area of project management (PM) Franco et al. (2018), Terrazas (2009), Puentes and Guevara (2015), Todorovic, Petrović, Mihić, Obradović, and

Bushuyev (2015), Espinoza (2009) point out that this area is a fundamental discipline for the implementation, development and operation of projects that need to measure and evaluate the results that are achieved, partial and final results, estimate and compare deadlines, costs, quality, objectives, risks among others; these actions and parameters can be addressed based on the concepts and techniques of project management, whose standards are established in the PMBOK7 Guide 2021. The GP implies the adequate control of the development of the implemented plans and it is at the control points where the monitoring and follow-up of metrics or performance indicators are a useful measurement tool to establish the levels of achievement of the deliverable, quality and success of the project, in this case of the agricultural MSMEs. Therefore, the management of any company must be developed and treated in a scientific manner, consequently, empiricism and improvisation must be replaced by scientific management techniques.

In relation to related disciplines Robles and Alcérreca (2009), Ramírez and Ramírez (2016), Zamora (2015) specify that GE receives contributions from other scientific disciplines among which stand out: engineering, psychology, sociology, anthropology, operations research and statistics; as well as, economics, mathematics are fundamental knowledge and competencies to solve administrative problems.

The main related theories include real options theories, planning theories, financial theory, administrative theories, business management theories, and decision making theories. Among the authors who explain these theories are Calle and Tamayo (2009), Pascale and Pascale (2011), Carrasco, Cuzco, Correa, Vinueza, and Cabrera (2018), Vidal (2012), Agüero (2007), Forcael, Andalaft, Schovelin, and Vargas (2013). In relation to the theory of real options, these are applied in the valuation of non-financial assets, such as investment in research; it is a complementary tool in the evaluation of projects, which allows implementing and evaluating the strategic component of the projects in a systematic and methodical manner, and can also use information regarding financial markets. Finance is a branch of economics applied to microeconomics. Strategic planning from the point of view of the administrative sciences includes the systematically ordered set of results of an organization, and management theory in its different approaches attempts to know, understand, describe, explain and predict the behavior of organizations. There are two decision theories. The first is based on the decision process from a critical theory of linear multirationalism, which states that the decision is a process of interactions, being considered as an institutional process based on the freedom of the subject. The second is based on the theory of self-referential systems, which conceives the organization as a decision system, and understands the concept of decision, in its purely epistemological specificity, by abstracting from the decision all the elements and organizational variables related to it, that the theory of real options is a complementary tool in the evaluation of projects, which allows implementing and evaluating the strategic component of projects in a systematic and methodical manner, and can also use the information on financial markets.

The scientific disciplines involved in the subject are management, economics, finance and geopolitics. Among the authors who explain this topic are Álvarez (2016), Pampliega (2014), Ortega (2002), Muñoz and Avendaño (2014) who explain that organizational capabilities, as administrative, operational and project management enablers and their continuous improvement, are fundamental elements to deliver products and services to the customer. In this sense, projects are a necessity in organizations in order to assume the changes involved in adapting to the current market. Project Management, therefore, provides more advantages than any other management approach, both in terms of maximizing quality and efficiently managing resources, and becomes a priority competency for the leaders of these organizations. On the other hand, finance is a discipline that, with the help of other disciplines such as accounting, law and economics, seeks to optimize the management of the company's

human and material resources. Geopolitics constitutes a tool that allows the recognition of institutions as mental representations, useful to man in society for the definition of rules of the game that allow him to interact and reduce uncertainty, in his categorical relations of space-time, nature, population-economy.

Regarding Project, HMD Project Management (2016), defines project as a temporary effort that is undertaken to create a unique product, service or result. Insight Projets (2020) and Perez (2020) also point out that projects must deliver value to the business. This value creation system is related to corporate strategy. In the creation of value, the capacity for innovation and the efficient use of technology play a fundamental role in achieving better results.

Concerning Project Management the Universidad Internacional Iberoamericana (UNINI, 2018), defines project management as the set of processes that lead to the optimization, in the use of human and material resources for the achievement of project objectives. The Project Management Institute (2017) defines it as the application of knowledge, skills, tools and techniques to project activities in order to meet each of the project requirements. Likewise, Wallace (2014), the Association for Project Management (2019), and Estrada (2015), define project management as strategic competence, resource management, application of competencies, achievement of cost, time and quality objectives, useful tool for future business operations.

Regarding Innovation Management (IM) Robledo (2019), Guerra, Pérez and Fonet (2014), Mejías and Morejón (2017), the Economic Commission for Latin America and the Caribbean (ECLAC, 2016), Maravert, Molina, and Molina (2016) explain that IM is a systemic model of organizational congruence, whose performance is the complex result of the congruent interaction of environment, strategy and innovation capabilities. Its relevance lies in the fact that the socioeconomic development of nations and organizations is related to innovation. The development of innovative capacity is an essential factor for the business system and its quality according to international standards. There are three essential aspects of innovation: (a) development of new products, processes and ways of organizing production, its economic and social structures with quantitative and qualitative changes; (b) that all sustained growth processes drive the generation of scientific and technological capabilities; and (c) that investment in R&D is one of the main indicators of technological and innovative effort.

Another fundamental aspect of the approach to the object of study was the analysis of the

national, departmental and municipal development plans that promote development, competitiveness and innovation in the rural and agricultural sector. Therefore, Duque (2018) in the National Development Plan 2018-2022, "establishes an alliance to energize the development and productivity of rural Colombia" (p.50). Serrano, (2020, p. 4) in the Development Plan of Norte de Santander 2020-2023, establishes in its vision 2050, a model of sustainable territorial development that has as its main commitment agribusiness, Science, Innovation and Technology. Meanwhile, Yáñez (2020), in the Municipal Development Plan, elaborated the Cúcuta plan: Siembra y Transforma, with the purpose of promoting productive transformation, improving the performance of agricultural and livestock items in rural areas, through the promotion of the following factors: (a) Improvement of productivity and sustainability of different crops, (b) Generation of value added to agricultural and agroindustrial products, (c) Promotion of technological tools that encourage planning, (d) Coordination with the educational sector to bring together the academic training offer with technical emphasis.

From the analysis of the background, the approach to the object of study and the national development plans, the need to answer the following question has been identified: what are the management factors that affect innovation in agricultural MSMEs in Norte de Santander?

## **Method**

In order to answer the research question, a quantitative, correlational and field design study was developed, and data were collected through the application of scale instruments to the different study units that will make up the research sample. The study was carried out in Norte de Santander, one of the thirty-two (32) departments that, together with Bogotá, Capital District, make up the Republic of Colombia. It is a territorial entity, whose capital is the city of Cúcuta, which enjoys autonomy for the administration of sectional affairs and the planning and promotion of economic and social development within its territory, has an area of 22,648 km<sup>2</sup>, equivalent to 1.91% of the national territory, located in the northeastern region of Colombia. It is a border area with the State of Táchira and Zulia State of the Bolivarian Republic of Venezuela, which stands out for its industrial activity and the exploitation of its natural resources such as coal and oil, is the main axis of the economy and exports are directed to neighboring countries such as Venezuela and Ecuador. Agriculture is the basis of the economy with products such as cotton, tobacco, cocoa, sugar cane, rice, coffee, cachama and red tilapia; where the study units were observed, and the observation units, broken down from the operationalization of the variables. The procedures were contemplated in 3 phases, as follows: (a) preparation phase: design and validation of instruments; (b) interactive phase: application of instruments; (c) analytical phase: correlation of variables. The data collection instrument was validated by experts in management sciences.

The hypothesis system guiding the research is as follows:

H1: The lack of competence of managers and the lack of coordination with the public sector positively affect innovation in agricultural MSMEs in Norte de Santander.

H0: The lack of managerial competence and articulation with the public sector negatively affects innovation in agricultural MSMEs in Norte de Santander.

H2: The lack of managerial skills, coordination with the private sector, technology transfer and knowledge management affect innovation in agricultural MSMEs in Norte de Santander.

H0: The lack of managerial skills, articulation with the private sector, technology transfer and knowledge management do not affect innovation in agricultural MSMEs in Norte de Santander.

H3: The lower the managerial knowledge, the lower the investment in technical services, training and knowledge transfer in agricultural MSMEs in Norte de Santander

H0: The lesser the managerial knowledge, the lesser the investment in technical services, training and knowledge transfer in agricultural MSMEs in Norte de Santander

H4: The lack of articulation, knowledge transfer and knowledge management in the agricultural MSMEs of Norte de Santander positively affects the innovation of the UPAs.

H0: The lack of articulation, knowledge transfer and knowledge management of agricultural MSMEs in Norte de Santander negatively affects the innovation of the UPAs

H5: The lack of articulation with the private sector positively affects knowledge transfer and knowledge management in agricultural MSMEs in Norte de Santander.

H0: The lack of coordination with the private sector negatively affects knowledge transfer and knowledge management in agricultural MSMEs in Norte de Santander.

H6: The less articulation with the private sector, the less investment in knowledge transfer for innovation in agricultural MSMEs in Norte de Santander.

H0: The lesser the articulation with the private sector, the lesser the investment in knowledge transfer for innovation in agricultural MSMEs in Norte de Santander.

H7: The lesser the transfer of technology and knowledge management, the lesser the innovation in agricultural MSMEs in Norte de Santander.

H0: The lesser the technology transfer and knowledge management, the lesser the innovation in agricultural MSMEs in Norte de Santander.

H8: The greater the investment in technology transfer training courses for workers provided by universities, the smaller the technology transfer and innovation gap in agricultural MSMEs in Norte de Santander.

H0: The greater the investment in training courses for workers in technology transfer provided by universities, the greater the gap in technology transfer and innovation in agricultural MSMEs in Norte de Santander.

H9: The lack of investment in worker training services provided by universities negatively affects knowledge management in agricultural MSMEs in Norte de Santander.

H0: The lack of investment in worker training services provided by universities does not affect knowledge management in agricultural MSMEs in Norte de Santander.

The population consisted of 854 agricultural MSMEs in the Department of Norte de Santander. From this population, 50 study units were selected to form the research sample; the type of sampling used was non-probabilistic and intentional. The operationalization of the variable breaks down the following variables: (a) managerial management: pragmatic management, competent management, innovation, knowledge management, managerial competence, managerial knowledge and (b) agricultural factors: science, technology, agricultural manager competencies and workers and investment.

The instruments were applied to 50 information units (farm owners, managers or administrators). The research data collection instruments used were scaled instruments. The validation of the instruments was carried out ad hoc for this research by three doctors in management sciences, who were formally requested to review the instrument and analyze it according to four criteria, namely: (a) consistency of the items with the objectives, (b) relevance, (c) wording, and (d) content validity, the reliability score was 0.8.

For the analysis of the data, the Kolmogorov Smirnow test was applied, which evaluates the assumption of normality in each of the variables linked to the multivariate analysis, and it was concluded that none presented normal behavior ( $p < 0.05$ ), so the correlation and analysis of variance tests used were Kendal's Tau b correlation coefficient and the Kruskal Wallis H test, the nonparametric equivalent of ANOVA in independent groups.

## **Results**

The results of the correlations between the variables of interest in the multivariate analysis determined that determined the following:

**Table 1**  
*Normality tests for variables of interest in multivariate analysis*

Group	Variable	Kolmogorov-Smirnov <sup>a</sup>		
		Statistician	gl	Sig.
Competent management	Timing of training activities.	0,305	50	0,000
	Approximate amount of payment to universities, in the last five years 2017-2021 for training of workers of agribusiness MSMEs	0,467	50	0,000
	MSMEs workers participate in knowledge transfer processes	0,500	50	0,000
	Approximate amount paid to universities or formal institutions for technical services provided to agricultural MSMEs.	0,401	50	0,000
Pragmatic management	Amount invested in the transfer of knowledge by its management on the farm	0,370	50	0,000
	Trainings in knowledge transfer processes involve owners, manager or workers of agricultural MSMEs, in the last five years 2017-2021.	0,447	50	0,000
	Agricultural software used in management processes	0,529	50	0,000
	Number of programs or projects developed between the university and producer associations or chambers of commerce to promote and develop on-farm innovation.	0,540	50	0,000
Management and innovation	Management competencies	0,279	50	0,000
	Articulation with the public sector	0,271	50	0,000
	Articulation with the private sector	0,300	50	0,000
	Technology transfer	0,320	50	0,000
	Knowledge management	0,267	50	0,000

Table 1. It includes the results for the Kolmogorov Smirnow test, which evaluates the assumption of normality in each of the variables linked to the multivariate analysis, concluding that none presented normal behavior ( $p < 0.05$ ), so the correlation and analysis of variance tests used were Kendal's Tau b correlation coefficient and the Kruskal Wallis H test, the nonparametric equivalent of ANOVA in independent groups.



**Table 2**

*Bivariate correlation matrix between the variables of pragmatic management, competent management and innovation*

	Correlation coefficient Kendall's Tau B correlation coefficient	Timing of training activities.	Managerial competencies affect innovation in agricultural MSMEs.	The lack of coordination between the public sector and agricultural MSMEs affects on-farm innovation.	The lack of coordination between the private sector and agricultural MSMEs affects on-farm innovation.	The lack of technology transfer in agricultural MSMEs affects on-farm innovation.	Lack of knowledge management in agricultural MSMEs affects on-farm innovation.	Approximate amount of payment to universities, in the last five years 2017-2021 for training of workers of agricultural MSMEs	MSMEs workers participate in knowledge transfer processes	Approximate amount paid to universities or formal institutions for technical services provided to agricultural MSMEs.	Amount invested in the transfer of knowledge by its management on the farm	Trainings in knowledge transfer processes involve owners, manager or workers of agricultural MSMEs, in the last five years 2017-2021.	Agricultural software used in management processes	Number of programs or projects developed between the university and producer associations or chambers of commerce to promote and develop on-farm innovation.
Timing of training activities.	Correlation coefficient	1	0,013	-0,115	-0,105	0,111	-0,059	0,133	0,015	0,046	0,114	0,014	-	0,117
	p-value	.	0,920	0,371	0,412	0,387	0,641	0,316	0,908	0,735	0,399	0,914	0,138	0,387
Managerial competencies affect innovation in agricultural MSMEs.	Correlation coefficient		1	0,474**	0,479**	0,602**	0,622**	-	0,135	0,310*	0,420*	-	-	-
	p-value		.	0,000	0,000	0,000	0,000	0,183	0,313	0,021	0,002	0,106	0,139	0,808
The lack of coordination between the public sector and agricultural MSMEs affects on-farm innovation.	Correlation coefficient			1	0,693**	0,298*	0,608**	-	0,099	0,051	-	-	0,012	-
	p-value			.	0,000	0,020	0,000	0,380	0,461	0,710	0,188	0,428	0,929	0,807
The lack of coordination between the private sector and agricultural MSMEs affects on-farm innovation.	Correlation coefficient				1	0,545**	0,586**	-	0,081	0,061	0,272*	-	0,072	-
	p-value				.	0,000	0,000	0,249	0,545	0,655	0,045	0,256	0,597	0,726
The lack of technology transfer in agricultural MSMEs affects	Correlation coefficient					1	0,645**	-	0,134	-	-	-	-	-
	p-value					.	0,000	0,049	0,316	0,156	0,031	0,216	0,739	0,668

on-farm innovation.	Lack of knowledge management in agricultural MSMEs affects on-farm innovation.	of in	Correlation coefficient								
				1	-.275*	0,061	0,206	0,243	-0,17	0,054	0,043
			p-value	.	0,036	0,647	0,125	0,071	0,196	0,687	0,748

Table 2. Corresponds to the matrix of bivariate correlations between the variables of pragmatic management, competent management and innovation. A direct and statistically significant correlation was found between the lack of managerial competence and the lack of coordination with the public sector as factors affecting innovation in agricultural MSMEs ( $p < 0.05$ ). There was also a positive correlation between the lack of managerial skills and the lack of coordination with the private sector, the lack of technology transfer and knowledge management, as factors affecting innovation in agricultural MSMEs ( $p < 0.05$ ).

On the other hand, an inverse and statistically significant correlation was observed between the lack of managerial competence and the amounts paid to universities or formal institutions for technical services, as well as the amount paid for training and knowledge transfer processes, determining that the greater the lack of managerial knowledge, the lower the investment in this type of services that would result in the improvement of production processes ( $p < 0.05$ ). There was a positive and significant correlation between the lack of articulation by MSMEs with the public and private sectors, as well as with the lack of articulation with the public sector and knowledge transfer, and with the lack of articulation with the public sector and the lack of knowledge management, these aspects being reflected in the low level of innovation of these companies ( $p < 0.05$ ). An inverse and significant correlation was found between the lack of articulation with the private sector and the lack of knowledge transfer and knowledge management ( $p < 0.05$ ).

There was also an inverse and statistically significant correlation between the lack of articulation with the private sector and the amount of investment in knowledge transfer, showing that, in the absence of articulation with the private sector, there is less investment in knowledge transfer for innovation ( $p < 0.05$ ).

There is a positive and statistically significant correlation between the lack of technology transfer and knowledge management as determinants of low innovation in these agricultural enterprises ( $p < 0.05$ ).

An inverse and statistically significant correlation was observed between the lack of technology transfer and the approximate amount of payment to universities, in the last five years 2017-2021 for training workers of agricultural MSMEs, as well as with the amount invested in knowledge transfer for their on-farm management, so that in these companies there is little investment in training workers and knowledge transfer, which translates into a greater gap in technology transfer and innovation ( $p < 0.05$ ). Likewise, an inverse and statistically significant correlation was evidenced between the lack of knowledge management and the approximate amount of payment to universities, in the last five years 2017-2021 for training workers ( $p < 0.05$ ). There was no significant correlation between the variables corresponding to pragmatic management and the time spent in training activities, since, as was identified, there is very little investment and time given to workers to carry out this type of activity ( $p > 0.05$ ). There was also no significant correlation between the innovation variables and the time spent in training activities, which affects the competitiveness of this sector ( $p > 0.05$ ).

For the analysis of variance, all variables related to management and innovation were defined as dependent variables, and variables related to pragmatic management were defined as random factors.

**Table 3**

*Kruskall Wallis H-test for management variables with respect to the approximate amount paid to universities in the last 5 years for employee training*

	Managers' competencies affect innovation in agricultural MSMEs.	The lack of coordination between the public sector and agricultural MSMEs affects on-farm innovation.	The lack of coordination between the private sector and agricultural MSMEs affects on-farm innovation.	The lack of technology transfer in agricultural MSMEs affects on-farm innovation.	The lack of knowledge management in agricultural MSMEs affects on-farm innovation.
Kruskal-Wallis H	2,284	0,863	1,444	3,869	4,431
gl	2	2	2	2	2
Asymptotic sig	0,319	0,650	0,486	0,144	0,109

a. Kruskal Wallis test

b. Grouping variable: Approximate amount of payment to universities, in the last five years 2017-2021 for training of workers of agribusiness MSMEs

Management management and innovation do not differ with respect to the amount of investment in training programs for their workers with the educational sector ( $p < 0.05$ ). This is due to the fact that most of these companies have invested less than 2 million pesos in the last five years.

**Table 4**

*Kruskall Wallis H-test for managerial variables with respect to the number of workers participating in the knowledge transfer processes*

	Managers' competencies affect innovation in agricultural MSMEs.	The lack of coordination between the public sector and agricultural MSMEs affects on-farm innovation.	The lack of coordination between the private sector and agricultural MSMEs affects on-farm innovation.	The lack of technology transfer in agricultural MSMEs affects on-farm innovation.	The lack of knowledge management in agricultural MSMEs affects on-farm innovation.
Kruskal-Wallis H	3,061	2,414	2,295	3,528	1,757
gl	2	2	2	2	2
Asymptotic sig	0,216	0,299	0,317	0,171	0,415

a. Kruskal Wallis test

b. Grouping variable: MSMEs workers participate in knowledge transfer processes

Management and innovation management do not show statistically significant differences with respect to the number of workers participating in knowledge transfer processes ( $p < 0.05$ ). This is explained by the fact that most of the companies have employed only 5 or less workers in these processes.

**Table 5**

*Kruskall Wallis H-test for managerial variables with respect to the amount paid to universities or formal institutions for technical services*

	Managers' competencies affect innovation in agricultural MSMEs.	The lack of coordination between the public sector and agricultural MSMEs affects on-farm innovation.	The lack of coordination between the private sector and agricultural MSMEs affects on-farm innovation.	The lack of technology transfer in agricultural MSMEs affects on-farm innovation.	The lack of knowledge management in agricultural MSMEs affects on-farm innovation.
Kruskal-Wallis H	5,288	0,138	0,2	2,013	2,358
gl	1	1	1	1	1
Asymptotic sig	0,021	0,710	0,655	0,156	0,125

a. Kruskal Wallis test  
 b. Grouping variable: Approximate amount paid to universities or formal institutions for technical services provided to agricultural MSMEs.

**Source:** Jael Contreras Rangel (2021).

It was possible to determine that managerial management, specifically managerial competencies are affected and differ significantly with respect to the investments made by the entrepreneurs in the payment of technical services to universities or institutions, observing a greater lack of managerial competencies in those entrepreneurs who have invested few resources in the provision of technical services ( $p < 0.05$ ).

**Table 6**

*Kruskall Wallis H-test for management variables with respect to the amount invested in knowledge transfer*

	Managerial competencies affect innovation in agricultural MSMEs.	The lack of coordination between the public sector and agricultural MSMEs affects on-farm innovation.	The lack of coordination between the private sector and agricultural MSMEs affects on-farm innovation.	The lack of technology transfer in agricultural MSMEs affects on-farm innovation.	Lack of knowledge management in agricultural MSMEs affects on-farm innovation.
Kruskal-Wallis H	9,751	1,733	4,015	4,667	3,269
gl	1	1	1	1	1
Asymptotic sig	0,002	0,188	0,045	0,031	0,071

a. Kruskal Wallis test  
 b. Grouping variable: Amount invested in the transfer of knowledge by its management on the farm

It was possible to determine that innovation management differs significantly with respect to managerial competencies, articulation with the private sector and technology transfer, with respect to the amount of investment in knowledge transfer, with a greater lack of

managerial and innovation competencies being observed in those companies with little investment in knowledge transfer ( $p < 0.05$ ).

**Table 7**

*Kruskall Wallis H-test for management and innovation variables with respect to the number of trainings in knowledge transfer processes*

	Managerial competencies affect innovation in agricultural MSMEs.	The lack of coordination between the public sector and agricultural MSMEs affects on-farm innovation.	The lack of coordination between the private sector and agricultural MSMEs affects on-farm innovation.	The lack of technology transfer in agricultural MSMEs affects on-farm innovation.	Lack of knowledge management in agricultural MSMEs affects on-farm innovation.
Kruskal-Wallis H	2,656	0,702	1,422	3,745	1,892
gl	2	2	2	2	2
Asymptotic sig	0,265	0,704	0,491	0,154	0,388
a. Kruskal Wallis test					
b. Grouping variable: Trainings in knowledge transfer processes involve owners, manager or workers of agricultural MSMEs, in the last five years 2017-2021.					

Although it was found that the lower the number of training courses, the greater the lack of management and innovation, there were no statistically significant differences, which suggests that the lack of innovation does not differ with respect to the number of training courses in the knowledge transfer processes ( $p > 0.05$ ).

**Table 8**

*Wallis H-test for managerial management and innovation variables with respect to the use of agricultural software used in management processes*

	Managers' competencies affect innovation in agricultural MSMEs.	The lack of coordination between the public sector and agricultural MSMEs affects on-farm innovation.	The lack of coordination between the private sector and agricultural MSMEs affects on-farm innovation.	The lack of technology transfer in agricultural MSMEs affects on-farm innovation.	The lack of knowledge management in agricultural MSMEs affects on-farm innovation.
Kruskal-Wallis H	2,194	0,008	0,28	0,111	0,162
gl	1	1	1	1	1
Asymptotic sig	0,139	0,929	0,597	0,739	0,687
a. Kruskal Wallis test					
b. Grouping variable: Agricultural software used in management processes					

There were also no statistically significant differences in the level of management skills and innovation with respect to the use of agricultural software in production processes ( $p > 0.05$ ), although clearly most of these companies have invested little in this type of technology.

**Table 9**

*Kruskall Wallis H-test for management and innovation variables regarding the number of programs or projects that are developed jointly with the educational and business sectors to promote and develop innovation on their farms*

	Managers' competencies affect innovation in agricultural MSMEs.	The lack of coordination between the public sector and agricultural MSMEs affects on-farm innovation.	The lack of coordination between the private sector and agricultural MSMEs affects on-farm innovation.	The lack of technology transfer in agricultural MSMEs affects on-farm innovation.	The lack of knowledge management in agricultural MSMEs affects on-farm innovation.
Kruskal-Wallis H	0,059	0,06	0,123	0,184	0,103
gl	1	1	1	1	1
Asymptotic sig	0,808	0,807	0,726	0,668	0,748
a. Kruskal Wallis test					
b. Grouping variable: Number of programs or projects developed between the university and producer associations or chambers of commerce to promote and develop on-farm innovation.					

Given that most of the companies have only developed 2 or less projects related to the promotion and development of innovation on their farms (96%), the lack of general and innovation competencies is similar among them, and cannot be differentiated with respect to the number of projects implemented ( $p > 0.05$ ).

### Discussion and conclusions

With the application of the Kolmogorov Smirnow test, the use of correlation tests and analysis of variance of Kendal's Tau b correlation coefficient and the Kruskal Wallis H-test, the nonparametric equivalent of ANOVA in independent groups, is determined.

Regarding the bivariate correlations between the variables of pragmatic management, competent management and innovation, a direct and significant correlation is determined between the lack of competence of managers and the lack of articulation with the public sector as factors affecting innovation in agricultural MSMEs ( $p < 0.05$ ), a result that corroborates H0: The lack of managerial competence and articulation with the public sector negatively affects innovation in agricultural MSMEs in Norte de Santander. There is also a positive correlation between the lack of managerial competencies and the lack of articulation with the private sector, the lack of technology transfer and knowledge management, as factors affecting innovation in the UPAs ( $p < 0.05$ ), which corroborates H2: The lack of managerial skills, coordination with the private sector, technology transfer and knowledge management affect innovation in agricultural MSMEs in Norte de Santander. These results are consistent with those of Melo and Fonseca (2014), who show the predominance of pragmatic management, based on what is learned through experience and not on professional studies, since only 36% of the managers had a professional degree; they also point out that managers must improve their ability to innovate, these results differ from those found by Camacho (2018), who determined with respect to the professional level, that 60% were professional graduates, 20% were university

graduates, 20% were not professionals, however, none were in the area of agronomy or agricultural sciences, but he did observe high effectiveness and efficiency in their performance.

On the other hand, there is an inverse and significant correlation between the lack of managerial competence and the amounts paid to universities or formal institutions for technical services, training and knowledge transfer, a situation that corroborates that the greater the lack of managerial knowledge, the less investment in this type of services ( $p < 0.05$ ), this result corroborates H3: The lower the managerial knowledge, the lower the investment in technical services, training and knowledge transfer in agricultural MSMEs in Norte de Santander. These results are similar to those of Melo and Fonseca (2014) who find that only 39% developed research and development activities, these results differ from those of Zayas (2018) who obtained that 100% have made technological innovations, both in their machinery and seed, adds regarding economic expenditure that 81.25% do not cause economic problems to implement innovations, 12.5% if it causes economic problems and 6.2% answer that sometimes causes economic problems.

Also, there is a positive and significant correlation between the lack of articulation by MSMEs with the public and private sector, and knowledge transfer, knowledge management, with little innovation ( $p < 0.05$ ), as well as an inverse and significant correlation between the lack of articulation with the private sector, with the lack of knowledge transfer and knowledge management ( $p < 0.05$ ), results that corroborate the following hypotheses: H0: The lack of articulation, knowledge transfer and knowledge management of agricultural MSMEs in Norte de Santander negatively affects the innovation of the UPAs and the H0: The lack of coordination with the private sector negatively affects knowledge transfer and knowledge management in agricultural MSMEs in Norte de Santander. These results are consistent with those of Ferrer, González and Mendoza (2015) who observe in their study that the small company presents by its family character, the almost absolute control exercised by the owner over it, almost total absence of formal strategies, scarcity of information systems, low productivity and low investment in innovation due to the lack of innovation, little activity in R+D; these results differ with those of Tarapuez, Guzmán, and Parra (2016) who determine that the profile of award winning companies innovate, which are small, belong to the industrial sector, have formal processes for the formulation, implementation and monitoring of the strategic plan that take innovation into account and stimulate it, as well as initiatives and processes of change, relate to the environment to address research and development processes, have the capacity to adapt and incorporate new technologies. However, this profile contrasts with that of agricultural MSMEs, as pointed out by Ferrer et al. (2015) because of the family nature and the absence of formal strategies.

There is also a significant inverse correlation between the lack of coordination with the private sector and the amount of investment in knowledge transfer, which corroborates that, in the absence of coordination with the private sector, there is less investment in knowledge transfer for innovation ( $p < 0.05$ ). Likewise, there is a positive and significant correlation between the lack of technology transfer and knowledge management as determinants of low innovation in these agricultural enterprises ( $p < 0.05$ ), results that corroborate H6: The less articulation with the private sector, the less investment in knowledge transfer for innovation in agricultural MSMEs in Norte de Santander and H7: The lesser the transfer of technology and knowledge management, the lesser the innovation in agricultural MSMEs in Norte de Santander. These results are similar to those of Pereira (2019), who highlights that among the problems derived from weak management with the environment there are problems such as poor technical and business training, as well as their administrative, financial and operational management, among others; another problem is the very short time of sustainability only 50% of them survive the first year and 20% in the third year, due to the little importance they give



to innovation and knowledge. These results contrast with those of the diagnosis by Gómez and Borda (2020), who state that there are actions to support agricultural MSMEs, as well as the rest of the business development policy, focused on increasing the competitiveness of the companies; however, they identify that there are differentiated strategies according to the characteristics of the companies in terms of innovation and productivity. At the same time, cross-cutting measures have been implemented to improve the environment for MSMEs, including regulatory and normative issues and the development of support ecosystems.

Likewise, an inverse and statistically significant correlation is observed between the lack of technology transfer and the approximate amount paid to universities for training workers of agricultural MSMEs, as well as with the amount invested in knowledge transfer for their on-farm management, which implies a greater gap in technology transfer and innovation ( $p < 0$ ). This situation implies a greater gap in technology transfer and innovation ( $p < 0.05$ ). There is also an inverse and statistically significant correlation between the lack of knowledge management and the approximate amount paid to universities for worker training ( $p < 0.05$ ), results that corroborate H8: The greater the investment in training courses for workers in technology transfer provided by universities, the smaller the technology transfer and innovation gap in agricultural MSMEs in Norte de Santander and H9: The lack of investment in worker training services provided by universities negatively affects knowledge management in agricultural MSMEs in Norte de Santander. There was no significant correlation between the variables corresponding to pragmatic management and the time spent on training activities, since it was found that there is little investment and time given to workers to carry out this type of activity ( $p > 0.05$ ). There is also no significant correlation between innovation variables and time spent in training activities, which affects the competitiveness of this sector ( $p > 0.05$ ). These results are similar to those of Morales, Ortíz, and Arias (2012) who determine that interventionist governments, weak educational and financial systems, and low rates of investment in R&D activities, below 1% of GDP, which UNESCO considers to be the minimum to achieve development processes in science, technology and innovation. They also identified that the MSMEs that carry out R&D activities do not follow rigorous processes, in addition these activities are not clearly articulated with the business strategy; the activities focused on technological development are beginning to include it, there are also low rates of participation and training of human resources both at national and internal level of the organizations; regarding the relationship of the companies with their environment, the organizations with which the weakest links are established are the universities and research centers, unlike industrialized countries. These results are not similar to those of Astudillo (2015) who finds that innovation in MSMEs in Argentina and Ecuador evidences internal variables that determine the propensity to innovation in the product and in the process, the variable with a positive and significant effect in both countries and in the two typologies of innovation is research and development. In product innovation, other determinants are not revealed, and in process innovation, internal variables of the companies are associated, such as qualified human resources through training programs carried out by the companies and the certification of international quality standards.

In relation to the management factors that affect innovation, it is concluded that they are: the competencies of managers, the lack of coordination with the public and private sectors, the lack of technology transfer and knowledge management.

Regarding the limitations of the study, it is pertinent to highlight the following: (a) COVID-19 was one of the main limitations for the transfer and direct contact with the owners, managers and stewards of the farms; (b) government regulations by COVID-19, to control the transfer from one municipality to another, also constituted a limitation in the execution of the research.

As for the continuity of the study, although it is true that the information obtained in this research is useful for decision making to improve managerial management, nevertheless, in view of the deficiencies in managerial management and innovation in these MSMEs, it is proposed to continue with the line of research to design an adaptive model of projects as an alternative to the managerial management of agricultural MSMEs in Norte de Santander.

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