Structural Diagnosis, Analysis, and Proposals for the Guinea Pig (Cavia Porcellus) Meat Market in the Andean Region

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Abstract

The consumption of guinea pig meat has been increasing in recent years in the Andean regions. The objective of this research was to analyze how the variables that make up the guinea pig meat market and the actors associated with it are characterized and interrelated. Under an exploratory and descriptive non-experimental scope and by means of the MICMAC tool (matrix of crossed impacts), a structural analysis was carried out to identify the level of dependence and influence of the variables of the system, which were agreed upon by a select group of specialists; as well as their interdependence with the main stakeholders involved. The results obtained show that the variables with the greatest impact on the market - and whose control would make it possible to optimize the functioning of the system - are linked to customary celebrations, consumption habits and the increase in the employment rate due to guinea pig raising. One of the most influential actors is the media, due to its significant impact on the behavior of the three previous variables, as well as on other relevant actors within the market. This research is a starting point for the strategic planning process of the market behavior of this type of meat in the Andean regions of South America.

Keywords
Guinea pig, meat, Andean region, market, planning.

1. Introduction

According to Guerrero et al. (2020), guinea pig meat is distinguished by its precocity and dietary flexibility, which, together with its extraordinary quality, make it an important food in people's diets, being able to compete with other domestic consumption species. Similarly, in agreement with Flores et al. (2018), this meat is characterized by its high nutritional content, as it is low in fat, has a minimum percentage of sodium, and has a high amount of protein, making it ideal to be included in a balanced diet suitable for people of any age and to be consumed in different physiological situations. The different eating habits have been changing in recent years; therefore, these should be adapted to easy preparation and should present ample opportunity for purchase in the markets (Estrada and Velastegui 2021). For this reason, the food security of the population must be guaranteed. Under Ortiz-Oblitas et al. (2021), this term is interpreted as the physical, social, and economic access to convenient quantities of food that are both safe and nutritious to adequately cover the nutritional needs of a healthy life.

Based on the above, the alternative of consuming this type of meat arises as an option to be able to meet the demand for food in the market. For this reason, this research seeks to analyze how the variables that make up the guinea pig meat market in the Andean region are characterized and interrelated. The guinea pig (Cavia porcellus), an animal native to the Andes of Peru and Bolivia, was trained by humans since ancestral times (Cantaro et al., 2021) in order to use it mainly as a food source (Segarra 2018); Peru being the country that enjoys the largest population of this species (Lucas et al. 2018). Currently, the Inca country is the largest producer and consumer of guinea pig meat in the world (Ministry of Agriculture and Irrigation 2019). According to the National Agricultural Survey (ENA 2017), around 18 million guinea pigs are raised through traditional family units.

This curious rodent is domesticated in large proportion by small farmers and is a symbol within the life and customs of indigenous societies where it is often used in medicine and even in magical and/or religious rituals (Guerrero et al. 2020). In addition to the above, in rural areas, in keeping with Cantaro et al. (2021), guinea pigs are usually raised for self-consumption and are a great alternative in their nutrition. It is considered a valuable food source for low-income populations. In developing countries, the raising of these animals constitutes a small but frequent economic income for families. In addition, it is important to know that in Andean countries there are different breeding systems, such as family, family-commercial, and commercial (Ortiz-Oblitas et al. 2021).

The consumption of guinea pig meat has been increasing in the international gastronomic market, presenting itself as a typical and exotic dish. Its meat is favored for its high nutritional value, its organoleptic properties, and the different ways of consuming it (Estrada and Velastegui Bosquez 2021).Since the world population has been growing steadily, it is expected that by the year 2050 the demand for food will be 70% higher than in 2010. Consequently, to, it is necessary to increase production, being meat one of the main products for food and with the objective of covering it is that guinea pig breeding has been increasing and now it is an important activity to generate income for commercial companies and peasant families (Cahui Galarza 2019). Despite the fact that its production costs are low compared to other animals, the consumption of guinea pig meat is minimal and this is due to its unappetizing presentation (Segarra 2018). However, people who consume this meat do so because of its high protein content, which is 21% higher than that of rabbit meat, and because it has 8% less fat than conventional meats (Kouakou et al. 2011).

Estrada and Velastegui (2021) mention the presence of different breeds in Peru, including the Criollo, Peru, Andean and Inti breeds. The first breed does not require sophisticated breeding facilities, can have two to three offspring and is not very well accepted in the market due to its color pigmentation, which ranges from black, brown and gray. The second is preferred mainly because it reaches its ideal weight for commercialization very soon. The Andean is chosen for its litter size (approximately 3 guinea pigs). Finally, the Inti is characterized by its precocity and prolificacy.
This type of non-conventional or exotic meat (Vargas Romero et al. 2020), can generate different types of reactions from consumers due to the different thoughts they have; however, its benefits have already been demonstrated and its acceptance is expected to expand in the coming years.

1.1 PEST analysis of the Andean guinea pig meat market

PEST analysis is a tool that consists of investigating external factors that may affect the future development of an organization's environment from a more general point of view (Martínez and Milla 2012). The factors that have a direct influence on the research are socio-cultural, political, technological and economic factors.
With respect to sociocultural factors, according to ethnohistoric and ethnographic evidence, guinea pigs are known to be consumed as food, as a tool in ancestral medicine, and as a divining agent; in addition, they have healing properties and are used as an offering (Rofes and Wheeler 2003). According to Fernández-Juárez (2010), one of the strategies found in folk healing in northern Peru, in the Andes and Amazonian groups is the cleansing of the sick. This ritual consists of passing the guinea pig over the body of the sick person; in this way, the animal will be contaminated with the ailments that the person may have and then disappear. It was raised throughout ancient Peru, including the coast and the Altiplano region, where it is still preserved and is more commonly found as a domestic animal (Salaverry 2012).

The political factor perceived as a significant catalyst for the increased consumption of guinea pig meat in recent years was the Peruvian government's initiative outlined in Supreme Decree No. 401-2019-EF. This decree exempted the payment of the General Sales Tax on live guinea pigs, intending to promote and enhance guinea pig production and trade, both in domestic and foreign markets within the country, as reported by Diario El Peruano (2019).
Regarding the technological factor, according to INIA-MINAGRI (2020), genetic quality has been enhanced in three high quality guinea pig breeds (Peru, Andean and Inti) in order to improve meat capacity and obtain greater weight in less time. Likewise, researchers are currently working on a new interbreed line by crossing these three breeds in order to generate a new breed that contains the best attributes of each type of guinea pig for the benefit of producers and marketers.

Finally, in terms of economic factors, guinea pig raising since ancient times was a strategy that made it possible to cope with the lack of access to a market for goods and labor, where resources were often scarce (Gascón 2021). Currently, guinea pig production is a profitable option in urban and peri-urban areas because it generates income for families; in other words, it makes it possible to increase employment through this activity (Seija Flórez 2011).

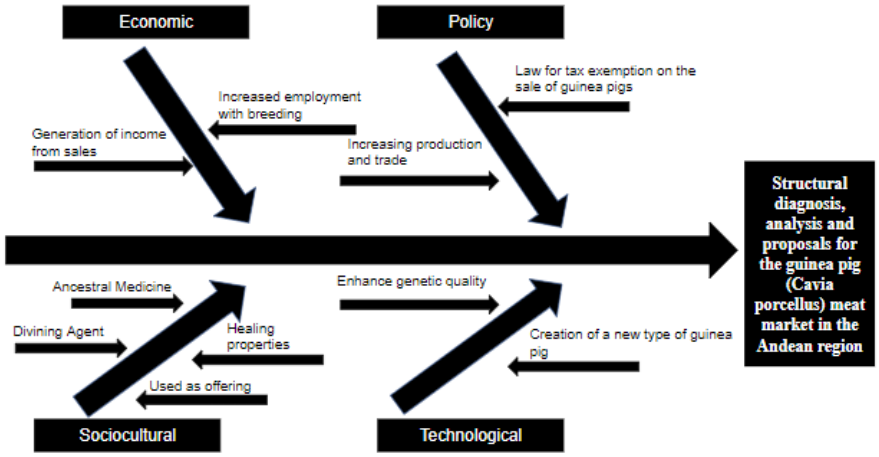

Figure 1. Pest Analysis of the guinea pig meat market

2. Literature Review

In agreement with Barbosa et al. (2020), through an analysis of twenty guinea pigs, including males and females, after being fed and slaughtered, the weight and yield of the carcass and meat quality were evaluated. As a result, it was found that for the production of guinea pig meat consumption, it is ideal for this animal to be male, since it has better growth, higher protein content, and a high yield concerning the carcass, meat and commercial cuts, since there are fewer losses due to cold and cooking.

Guinea pig breeding is a very important stage for the quality of the meat of this rodent, this is usually done in a traditional way; that is, in small spaces near the stoves of rural populations of scarce resources since ancestral times. Nevertheless, given the need to generate economic income for rural families, a commercial guinea pig production system began to be introduced and thus, by obtaining more income, it was possible to improve the lineage or breed in native guinea pigs, creating awareness of the importance of the genetic conservation of this animal throughout the Andean region (Avilés et al. 2014). Through research, it was possible to determine productive and reproductive indicators, obtaining similar reproductive indexes such as fertility in commercial farms in the highlands and on the coast. In addition, it was found that the weight of guinea pigs raised on farms on the coast is higher than in the highlands, the weight gain of guinea pigs is attributed to factors such as environmental temperature, litter size and the selection of breeders (Cahui 2019).

On the other hand, according to the research conducted by Segarra (2018), he mentions the relevant characteristics of guinea pig, emphasizing the high protein levels and low-fat content that this meat possesses. Likewise, he informs us that the breeding costs of this animal are low compared to those of other animals. However, at present, production is minimal due to the scarce consumption of this animal's meat. For this reason, this article seeks to present attractive alternatives in the presentation, such as hamburgers, to encourage the consumption of guinea pig meat. By describing the process of elaboration of the hamburger based on guinea pig meat, it is possible to demonstrate the great diversity of by-products that can be generated based on the meat of this rodent, providing consumers with alternatives of the product that are faster and more convenient for consumption.

Similarly, the characterization of guinea pig meat has led to the emergence of innovative consumption possibilities, such as the development of fermented sausages. In a study conducted on guinea pig varieties, including Criollo, Andean, and improved Peruvian, the primary objective was to identify the most suitable meat for fermented sausage production. The results indicated that all three varieties are optimal for this purpose, each offering distinct advantages. Specifically, the Criollo guinea pig meat is noted for its high protein content, the improved Peruvian guinea pig stands out for its elevated fat content, and both the improved Peruvian and Andean guinea pig varieties exhibit higher moisture levels (Flores et al.2016). Additionally, the article by Estrada and Velastegui (2021), explains the benefits of including guinea pig meat in our daily diet, highlighting its exceptional nutritional value. Under this context, the study of this research focused on characterizing vacuum-packed guinea pig meat for export and through an analysis sought

to improve the quality of the meat and optimize production systems. In order to satisfy the demand of the export market and comply with the health standards established in certain countries.

Through new creative perspectives such as food design, it has been possible to innovate in the use of new products, new utensils that improve gastronomy and improve the development of marketing strategies that are inspired by the gastronomic heritage of a community to promote and design new food experiences as a tool for cultural promotion (Potosí et al. 2020). In Mexico, there are guinea pig production systems, which have represented an opportunity for this meat to be sold locally and for self-consumption in different presentations. All of them have obtained great acceptance, positioning guinea pig meat as a non-traditional food source that can be integrated into the gastronomic market (Vargas et al. 2020).

3. Methods

The research was characterized by having an exploratory and descriptive scope, using a non-experimental cross-sectional design. The object of study focused on the system corresponding to the guinea pig meat market in the South American Andean region. For the process of structural analysis of this system, a non-probabilistic and purposive sample of five specialists linked to the agricultural sector and possessing a deep understanding of the market in question within the South American Andean region was used. Table 1 below details the profiles of the respondents. Their names have been withheld for ethical and confidentiality reasons.

Table 1. Profile of experts

Expert	Profile
E1	Head of the Research and Social Projection Program (PIPS) in Small Animals at the Universidad Nacional Agraria La Molina in Lima (Peru) with more than 50 years of experience.
E2	Former Liaison Coordinator of the Cooperative Program for Agricultural Research and Technology Transfer for the Andean Subregion (PROCIANDINO) with 45 years of experience in the Andean region.
E3	Zootechnical engineer and specialist in genetic improvement of guinea pigs with more than 50 years of experience in Andean market research.
E4	National and international university professor and zootechnical engineer with extensive experience in Andean market research and small animals.
E5	Commercial manager in the Andean guinea pig meat market and international researcher of the agricultural sector in South America.

Structural analysis is a tool that makes it possible to interrelate variables based on a matrix that makes it easy to explain the main components of the system to which they correspond (Labrín Mesía and Ruiz Ruiz 2022). This method encourages the collective reflection of a group of experts and makes its members analyze and try to reach a consensus from different points of view. In order to obtain, evaluate, and identify the possible variables and actors relevant to the research, a systematic literature review was initially carried out in the Scopus and Web of Science databases. Subsequently, the methodological design was structured in four stages, which are shown in Table 2 below.

Table 2. Phases of methodological design

Phase	Scope	Technique and/or tool	Validation
Phase 1: List of variables and actors.	List of variables and social actors linked to the guinea pig meat market.	Systematized documentary review (Scopus and Web of Science indexing databases).	Methodological review tracks

Phase 2: Identification of key variables for the system.	Identification of the relationships between the variables of the guinea pig meat market to determine the key variables.	Structural analysis (MICMAC) based on the cross-impact matrix.	Confirmation and collective consensus with experts.
Phase 3: Identification of key actors and relevant stakeholders.	Hierarchization of social actors	Power Matrix	Confirmation and collective consensus with experts
Phase 4: Development proposals for the market.	Analysis of the key variables and their interrelation with the social actors for the generation of development proposals.	Relational matrix of strategies, actors and key variables. Focus group	Triangulation and confirmation

The first phase consisted of drawing up a list of variables, in which the most important internal and external variables that characterize the guinea pig meat market were listed. In addition, a list was made of the social actors involved in the market. At this stage, the objective and meaning of each of the variables chosen were clearly and thoroughly established to avoid repetition or omission. The variables were confirmed by a team of experts through interviews that allowed their validation due to their experience in the subject. They were also grouped by dimensions as follows: economic, political, social and technological.

The second phase was based on the review of relationships between variables, which was developed with the help of a structural matrix of variables or a double-entry board (Arango et al. 2015). This activity was executed by experts in the guinea pig meat market who participated and reviewed the list to complete the matrix.
The specialists called to evaluate the level of influence (motricity) and dependence of one variable on another. According to the answers obtained, a value of 0 was assigned if the answer was negative. In the case of affirmative answers, they proceeded to ask whether the relationship was weak, medium, strong, or potential, assigning values of 1, 2, 3, and 4, respectively (La prospective n.d.). After the intervention of the experts, the key variables were identified and reviewed with the help of the MICMAC program. This was carried out by means of a classification of variables: direct, indirect, and potential. In other words, it is considered direct when it focuses on short- and medium-term relationships, which covers a period of less than ten years; indirect if it results from long-term relationships, centered on a time of ten to fifteen years, and potential if the relationships have effects in times greater than those mentioned above (Arias 2018).

By hierarchizing the variables in the different classifications, we can confirm their importance. The results of the variables obtained in this phase can be represented in a plane, where the ordinate axis corresponds to each variable established in terms of influence and the abscissa axis in terms of dependence (La prospective n.d.).

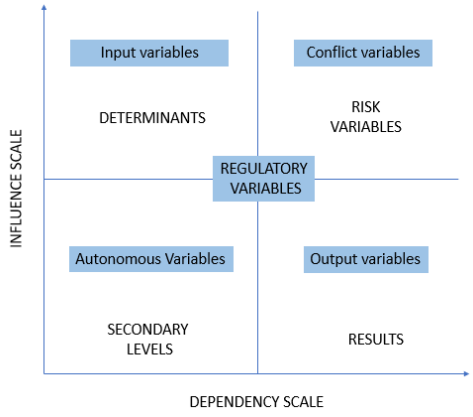

Figure 2. Influence-dependence graph

In the third phase, we proceeded to assign the levels of influence and mutual dependence among the actors, using the same relational matrix used in the analysis of the variables. With the collaboration of specialists who validated the initial variables studied, the relevant values were determined to position each actor at their respective level of power, as illustrated in Figure 3.

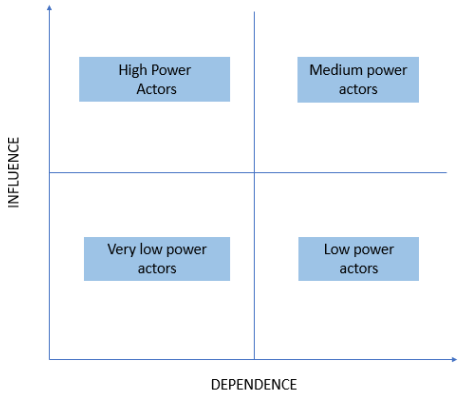

Figure 3. Areas of Stakeholder Power

In the final stage, the fourth phase, a matrix of relationships between the key variables and the most relevant actors was developed. This matrix provided a detailed understanding of the scope of the actors and their influence on the respective key variables in order to establish general guidelines for planning the market under study. It is important to note that the matrix was developed with the participation of the focus group composed of five specialists. These specialists, with their broad experience in the subject of study, contributed their perspectives through discussions that led to consensus, thus contributing to the rigorousness of the analysis.

4. Results and Discussion

4.1 Results

By the methodological phases defined in the previous section, the results obtained are presented below. Firstly, Table 3 presents a list of the 15 variables identified and validated for the guinea pig meat market with their respective base indicators or specifications, since the literature does not always include quantitative values for them.

Table 3. List of variables by dimension and their indicators of the guinea pig market

Code	Dimensions and variables	Base indicators and/or specification
Dimension: Economic		
V1	Profitability in the sale of guinea pigs	Income received by traders and producers. Currently, according to the Ministry of Agrarian Development and Irrigation (2023), there is an income of US$12 million from the purchase of guinea pigs in the Peruvian Andean market.
V2	Increasing the employment rate with guinea pig breeding	Percentage of labor growth with respect to formal and informal guinea pig farming
V3	Economic development	Percentage of GDP variation in the agricultural sector. Currently, a reduction of 14.2% of GDP is estimated, due to lower production (BCRP 2023).
V4	Rivalry in sales prices among other types of meat	Percentage difference between sales prices for different types of meat. Guinea pig meat has an average value of 12 to 18 USD slaughtered (Reyes-Silva et al. 2021), compared to chicken which costs around 6 USD (Ministry of Agrarian Development and Irrigation 2023); That is, the percentage difference between both sales prices is currently 50%.
Dimension: Politics		

V5	Government policies	Number of projects proposed by the government for the promotion and development of the production or consumption of guinea pig meat. Currently, there is a bill that includes guinea pig meat in the VAT exemption (Gestión 2023).
V6	State Budget	Budget assigned to the promotion of the production or consumption of guinea pig meat. There is an investment of approximately 9.40 million dollars (USD), which contributes to the production of guinea pig meat (Ministry of Agrarian Development and Irrigation 2023).
V7	Agreements between countries	Number of treaties that allow exports and imports of guinea pig meat. Currently, there is a proposed law that promotes the industrialization and export of guinea pig meat and its derivatives (Congress of the Republic of Peru 2023).
Dimension: Sociocultural		
V8	Ancestral medicine	Percentage of guinea pigs used for ancestral medicine
V9	Folk healing	Percentage of guinea pigs used as divination agents and in offerings
V10	Healing properties	Percentage of people with knowledge of the healing properties of consuming guinea pig meat
V11	Customary celebrations	Number of traditional celebrations where guinea pig consumption takes place
V12	Consumption habit	Tons of guinea pig meat consumed in the Andean region of South America. Currently, around 22 thousand tons of guinea pig meat are consumed in Peru (Ministry of Agrarian Development and Irrigation 2023).
Dimension: Technological		
V13	Processors	Number of formal guinea pig meat processing companies in Peru
V14	Forms of presentations	Number of presentation forms based on guinea pig meat. Studies indicate that it can be presented to make its consumption more attractive in sausages, mortadella, ham, chorizo, pate, hamburger, among others (Apráez et al. 2011).
V15	Genetic intervention	Number of new types of guinea pig created through genetic intervention. Currently, four breeds of guinea pig are known: Peru breed, Andean breed, Inti breed and Criolla breed (Estrada and Velastegui 2021).

Subsequently, a matrix was filled out with the help of specialists, in order to know the level of motor skills and dependence between the variables. The matrix was the input to obtain the direct and indirect impacts between them according to the MICMAC algorithm (La prospective n.d.). With this, it was possible to obtain Figure 4 with the 15

variables located in the Cartesian plane that allowed the structural analysis of the system taking into account the position of each of them.

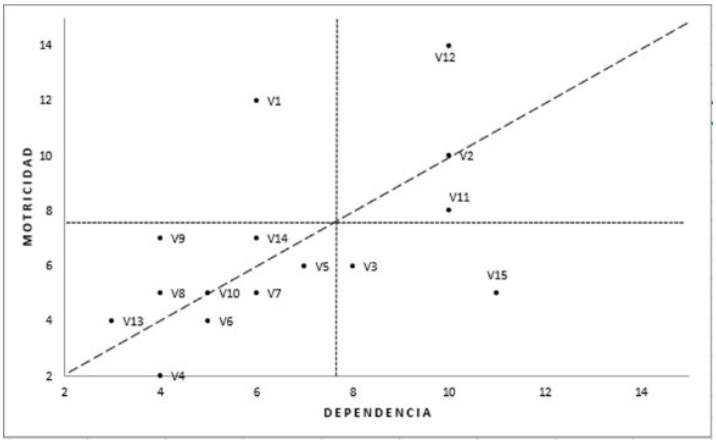

Figure 4. Matrix of direct and indirect impacts of the variables associated with the guinea pig meat market

Following the methodological sequence of several authors such as Limaymanta et al. (2022), the variables, developed in the structural diagnosis, were located in the following positions on the plane:

a) **Input variables:** These variables correspond to the power zone, being very influential and not so dependent. Located in the upper left part of the graph, the input variables have significant relevance in the system, as long as adequate control is exercised over them. The variable located in this quadrant is profitability in the sale of guinea pigs (V1).
b) **Conflict variable:** These correspond to variables that are very influential and have a high degree of dependence. They are located in the upper right part of the plane. Its particularity lies in the fact that, if altered, it could significantly affect the behavior of the other variables. In this area, according to the results obtained, the variables increase in the employment rate with the raising of guinea pigs (V2), traditional celebrations (V11), and consumption habits (V12).
c) **Autonomous variables:** They are little influential and dependent variables. They are located in the lower left part. For the most part, they do not have a great impact on the system, nor do they interrupt the development of the variables in it. They were located in this area: rivalry in sales prices between other types of meat (V4), government policies (V5), and state budget (V6). agreements between countries (V7), ancestral medicine (V8), folk healing (V9), healing properties (V10), processing (V13) and forms of presentations (V14).
d) **Output variable:** They are identified as variables with high dependence and little influence. They are located in the lower right region of the plane. Although they do not play a fundamental role in the evolution of the system, they can become sensitive in the development of power variables or conflict variables. As a result, the following variables were located in this area: economic development (V3) and genetic intervention (V15).

At the same time, in the following Table 4, a list of the ten social actors that participate in the guinea pig meat market is presented, accompanied by their respective descriptions. This relationship was subsequently subjected to the aforementioned hierarchization of the methodological section.

Table 4. List of social actors and their descriptions in the market

Code	Actors	Description
A1	Healers	He is in charge of carrying out healing practices through alternative medicine.
A2	Regional and district governments	Municipalities that support the dissemination of the breeding and consumption of guinea pig meat.

A3	Breeders	Responsible for the reproduction of animals and their raising until they reach the appropriate size.
A4	Collectors	People who buy and sell guinea pigs at different markets and fairs.
A5	Markets and Supermarkets	They are the places where activities are carried out that promote the purchase and sale of guinea pig meat in its different presentations.
A6	Fairs	They are the places where activities that promote the purchase and sale of guinea pigs are carried out.
A7	Restaurants	In charge of selling guinea pigs in their different presentations, promoting consumption by the population.
A8	Exporters	In charge of the sale of guinea pigs outside the country.
A9	Final Consumers	They are natural people who consume said meat.
A10	Social media	It is responsible for disseminating the benefits of the properties of guinea pig meat through various platforms.

Below, the ten social actors listed in Table 4 are presented on a Cartesian plane (Figure 5). These actors were ranked based on the same consultation with specialists.

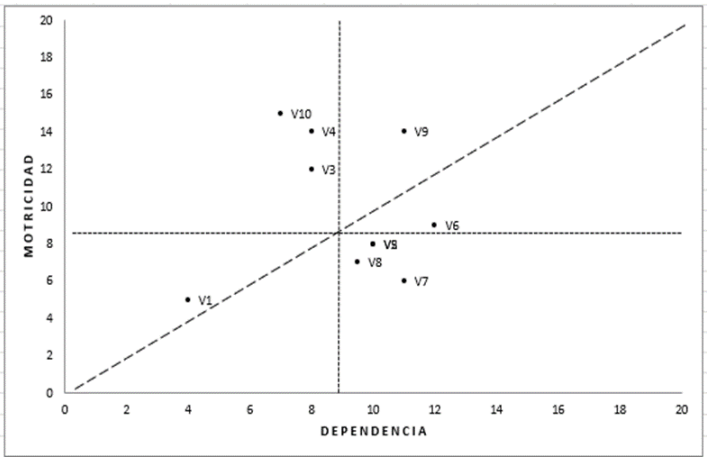

Figure 5. Matrix of the social actors of the guinea pig meat market

a) **High-power actors:** They reside in the upper left corner of the plane of influence and dependence, standing out for their significant capacity for influence and relative independence. In this region of influence, there are the media (V10), breeders (V3), and collectors (V4).
b) **Intermediate power actors:** Found in the upper right part of the plane, these actors exert considerable influence over others and, at the same time, present a marked dependence on other actors. This category includes final consumers (V9) and fairs (V6).
c) **Low-power actors:** Located in the lower right area of the plane of influence and dependence, these actors have a limited impact on others, but exhibit a strong dependence on other actors. This sector includes regional district governments (V2), markets and supermarkets (V5), restaurants (V7) and exporters (V8).
d) **Very low power actors:** Located in the lower left area of the plane of influence and dependence, these actors are characterized by their little influence and low dependence on other actors. This power segment is made up exclusively of healers (V1).

Finally, Table 5 presents the relationship matrix showing the influence of the three most important actors with respect to the three key variables obtained in Phase 2. This matrix was developed and validated with the collaboration of the same specialists.

Table 5. Relationship matrix between actors and key variables for market strategies

Key variables and social actors	Increase in the employment rate with guinea pig breeding	Customary celebrations	Consumption habit
Social media	There is no direct influence of the media on the increase in the employment rate related to guinea pig farming. Nonetheless, this actor facilitates the dissemination of information through various communication channels, which have the potential to promote and incentivize the practice of this activity.	The media provide the function of promoting the customs and traditions of the Andean regions, either through reports of festivities or through social networks, significantly influencing the dietary preferences of the population.	They promote the consumption of guinea pig meat through advertising campaigns on various platforms, highlighting its nutritional properties and encouraging gastronomic events in the Andean regions. Currently, it is estimated that 22 thousand tons of guinea pig meat are consumed in the Peruvian region (Ministry of Agrarian Development and Irrigation 2023).
Breeders	The influence of breeders on this variable is significant because they have the ability to stimulate employment generation. This encouragement can be manifested through the hiring of personnel to care for the guinea pigs or by offering advice to new breeders.	Breeders have a valuable impact on this variable, since they are the key suppliers of guinea pigs during Andean festivities where various culinary preparations are made. To date, there is an average annual growth of 5% in the guinea pig population to meet demand (Ministry of Agrarian Development and Irrigation 2023).	The influence of the breeders on this variable is presented in the production of guinea pigs, as they plan how to satisfy the demand for this meat in the Andean regions. According to the Ministry of Agrarian Development and Irrigation (2023), the existing population in a region gives the demand for guinea pigs. The main Peruvian regions are Cajamarca (20%), Cusco (17%) and Ancash (12%).
Collectors	They have a key role in generating significant demand through the buying and selling of guinea pigs. Its presence, supported by contacts in the markets, provides valuable opportunities for breeders to reach a larger population, thus contributing to the strengthening of guinea pig breeding.	In the same way as breeders, collectors have a crucial role in providing guinea pig meat at festive events. Its function is decisive, since it guarantees quality in the meat supplied, thus ensuring the excellence of the products that are part of these celebrations.	It directly affects consumption habits when considering the final sales price, both for the final consumer and for the different markets and supermarkets, which can affect the accessibility of the product. In conformity with the Ministry of Agrarian Development and Irrigation (2023), the main areas of consumption of guinea pig meat in Peru are the Central Sierra (36%), Lima Metropolitana (18%) and Southern Sierra (17%).

4.2 Discussion

The results derived from the analysis are corroborated by previous research. As per Estrada and Velastegui (2021), there has been an increase in the consumption of guinea pig meat in the gastronomic sphere. For this reason, the appearance of two key variables such as consumption habits and traditional celebrations is not unexpected. Considering the impact of these variables, it is vital to consider the supply of this meat in the markets. With a view to a prosperous future, Peru -as part of the Andean context- has a large population with respect to this species (Lucas et

al. 2018); raising an average 18 million guinea pigs (ENA 2017). Consequently, the Peruvian people have been considered the largest producer and consumer of guinea pigs (Ministry of Agriculture and Irrigation 2019).

Currently, guinea pig raising, according to Seija Flórez (2011), is consolidating as an economically viable option for Peruvian families, which underlines the importance of the variables associated with the increase in the employment rate in relation to this activity. Breeders, as social actor, play a significant role in this market, as they have a high level of influence. This is closely related to the observations of Cahui Galarza (2019), who has highlighted the increase in guinea pig breeding as a steadily growing source of income, which in turn stimulates the adoption of this practice in the Altiplano regions.

Despite being variables that depend on others, economic development (V3) and genetic intervention (V15) are equally important. On the one hand, thanks to economic development, traders have an opportunity in the labor market and a way to meet their expenses in the face of scarce resources as they have been doing for years (Gascón 2021). On the other hand, through genetic intervention, it is possible to develop new modified species designed for a specific purpose, as in the case of the search for a guinea pig for sausage production (Flores et al. 2016).
Likewise, variables that do not disrupt the guinea pig meat market were found, since these variables have little influence and dependence on each other, as in the case of price rivalry between other types of meat (V4). Reyes-Silva et al. (2021) introduced that the marketing of guinea pig meat is intrinsically linked to a variety of factors, including the presentation of the product, the quality of the meat, and its weight. The costs associated with production and labor in the agricultural sector, which has increased progressively over time, must be considered (Anaya et al. 2021).

Guinea pig meat is characterized as a premium meat, due to its high protein level and low level of fat compared to other meats on the market (Kouakou et al. 2011), which makes it a quality meat, differentiating it from the rest. Although the prestige of this meat is known, surprisingly, the State and private organizations do not influence and do not pay attention to promoting support for its breeding, even though it is the economic livelihood of many Andean families (Ortiz-Oblitas et al. 2021). The guinea pig meat market faces an important challenge in its development and promotion that involves the use of various means of communication, since as an actor in the market under study it has a high power of influence over the final consumer. According to Vargas Romero et al. (2020), guinea pig meat, being an exotic or unconventional type of meat, can evoke strong emotions, controversies, individual and social attitudes and even taboos for its acceptance. For this reason, it is essential to explore attractive gastronomic proposals from a sensory perspective to capture the consumer's interest.

Based on the matrix that analyzes the relationship between the key variables and the most significant actors in the system, the media stand out. Although they do not have a direct impact, their influence positions them as highly participatory actors. This fact translates into a stimulus for the production and consumption of guinea pig meat, which could motivate farmers to increase their employment rate. In addition, it would encourage the consumption of guinea pig meat, thus opening up the possibility of enabling guinea pig collectors to offer the product at a competitive price in the market. Rodríguez-Malebrán and Mohammadi (2022) mentioned that the media are crucial because they facilitate access to information for a broad segment of the population, making it possible to reach them through a variety of content. Because of the significant expansion and continuous growth of the media, the use of social networks as a digital marketing strategy is suggested. This proposal seeks to explore consumer behavior, strengthen their relationship with the product, and orient it effectively toward the target market. Andrade Yejas (2016) expressed that this initiative aims to favor the increase in sales, considering the massive reach and influence of social networking platforms today.

About the analysis and knowledge of the importance of guinea pig breeders and collectors, it is valuable to know certain types of improvement that could be implemented from the perspective of Industrial Engineering within this market. The Ishikawa diagram, a technique that allows the identification of different causes of a main problem (Burgasí Delgado et al. 2021), would provide the option of being able to evaluate in detail the profitability of guinea pig meat and its scope in the agricultural sector (Cantaro et al. 2021). At the same time, due to the increase in population and, consequently, its increase in food demand, the production speed of guinea pig meat must be increased (Cahui Galarza 2019). For this reason, one option to improve the production chain of a company dedicated to this consumable is the implementation of Lean Manufacturing methodology tools such as, for example, the 5S, which has the function of streamlining processes, providing productivity and eliminating activities that do not add value (Inga Salazar et al. 2022). Thus, according to data from the Ministry of Agrarian Development and Irrigation (2023), it is

proposed that the percentage of guinea pig consumption in Metropolitan Lima (18%) should reach the percentage (36%) consumed in the Central Highlands of Peru. This represents a considerable increase to be achieved.

In addition to the above, another strategy that stands out is the use of the Total Quality Management tool. Sousa-Mendes (2016) explained that this approach focuses on quality excellence within organizations, constituting a set of principles, methods and practices aimed at achieving customer satisfaction, employee involvement and continuous improvement. TQM aims to enhance the competitive capacity of companies and strengthen their position in the market. According to information from the Ministry of Agrarian Development and Irrigation (2023), guinea pig meat consumption is around 22,000 tons per year. This strategy represents an opportunity to improve the productive capacity of guinea pig farmers, who, in conformity with the Regional Directorate of Agriculture of Moquegua (2022), produce an average of 5,221 tons of guinea pig meat per year. In order to satisfy demand and generate consumer satisfaction, it is proposed that in the first year, at least 25% of the tons consumed could be reached, which would represent an increase of 1.27% over the current percentage of 23.73%.

5. Conclusion

This research made it possible to analyze in detail how the variables that make up the guinea pig meat market are characterized and interrelated. Through the PEST analysis and the application of the MICMAC tool, it was possible to identify key variables and the most relevant social actors, which showed their motricity and dependence within the system.

About the results found in the interrelation of variables and social actors, it was found that the habit of consuming guinea pig meat can be increased by encouraging its promotion and development through the media since they have a high degree of influence on the decisions of the target public. Moreover, this social actor plays an important role in traditional celebrations, where the tasting of the different presentations of guinea pig meat is centered. In addition, this study highlights the work carried out by breeders and collectors, who are responsible for the production and marketing of this rodent, thus satisfying the growing demand. In this way, they collaborate with an increase in the employment rate, as it encourages more families to choose guinea pig raising, improving their income and their contribution to household sustenance due to its considerable profitability.

It is important to recognize the valuable contribution that the strategies proposed can make to the industrial processes to which guinea pig meat is subjected without compromising its properties and quality. In addition, the implementation of marketing strategies could enrich the analysis of the target market's behavior, which, in the long term, would translate into competitive differentiation and customer loyalty. These goals can be quantitatively evaluated through the use of key performance indicators (KPIs).

The main limitation found during the research was the scarcity of detailed information on guinea pig meat. Most of the available data focused on the agricultural sector in general and other more commercial types of meat, such as sheep, pork and poultry. This study seeks to open up new lines of research that will make it possible to analyze and plan for the future - not only in the Andean region - the market for this type of ancestral meat, which is so peculiar and whose nutritional benefits are seldom recognized.

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