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**Leonardo Querido
Cardenas^{1*}
Diego Pacheco²
Fernando Dias Lopes³**

¹ Universidade Federal Rural do
Semi-Árido, Departamento de
Ciências Humanas, Mossoró - RN,
Brasil

² Centro Universitário Ritter dos
Reis – UniRitter - Departamento de
Engenharia de Produção - Porto
Alegre - RS, Brasil

³ Universidade Federal do Rio
Grande do Sul, Escola de
Administração, Porto Alegre - RS,
Brasil

* lquerido@ufersa.edu.br

THE AGRIBUSINESS INNOVATION IN BOVINE SUPPLY CHAIN IN BRAZIL: LANDSCAPE AND CHALLENGES

ABSTRACT

This paper seeks to identify the innovations in the Brazilian bovine chain over the past two decades. These innovations were analyzed following the four types of innovation proposed by Tidd, Bessant and Pavitt (2008): innovation of product, process, position and paradigm. Primary data was collected through semi-structured interviews with ten key actors in this production chain. These interviews were analyzed using content analysis whereas the secondary data were analyzed qualitatively by means of the document analysis technique. Results showed that several innovations occurred over the past two decades, essentially based on incremental focus, and directed to improving product quality and achieving production efficiency gains. Despite this progress, quality is still a challenge in the sector, limiting access to some markets. In this sense, the action of some stakeholders seems essential to overcome the barriers for development of this sector.

Keywords: Innovation; Bovine Chain; Agribusiness.

RESUMO

Esse artigo procurou identificar as inovações que ocorreram na cadeia bovina brasileira nas últimas duas décadas. Essas inovações foram analisadas de acordo com os quatro tipos de inovação propostos por Tidd, Bessant e Pavitt (2008): inovações de produto, processo, posição e paradigma. Os dados primários foram coletados por meio de entrevistas semiestruturadas com dez atores-chave dessa cadeia produtiva. Essas entrevistas foram analisadas pela técnica de análise de conteúdo. Já os dados secundários foram tratados qualitativamente pela técnica de análise documental. Os resultados demonstram que diversas inovações ocorreram no setor ao longo das últimas duas décadas, com foco essencialmente incremental. Observou-se que a maior parte dessas inovações foram direcionadas para incrementos na qualidade do produto e ganhos de eficiência produtiva. Contudo, apesar dessa evolução, a qualidade ainda é um desafio, limitando parcialmente o acesso a alguns mercados. Nesse sentido, a ação dos diversos agentes que atuam na atividade parece essencial para superar as barreiras para o desenvolvimento do setor.

Palavras -chave: Inovação; Cadeia Bovina; Agronegócio.

JEL Code: Q11; Q13; Q14.

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INTRODUCTION

Innovation has proved an essential strategy to ensure the business' survival. As argue Freeman and Soete (2008, p. 457), "do not innovate is to die". Here we refer to innovation as a quest, discovery, experimenting, development, imitation and adaptation of new products, new processes and new organizational formats (Dosi, 1988). In this scenario, the development of new capabilities becomes a requisite, a way of facing up to a great diversity of competitors that are innovating all the time. Failing to innovate will possibly mean losing competitiveness and ultimately business failure. According to Meeus and Oerlemans (2000), in any sector of economic activity, the maintenance of organizational inertia decreases the performance in the medium and short run and may ultimately go bust in the long run.

Moreover, it must be noted that innovation occur in different degrees in different productive activities. Whereas in manufacturing profound innovations have been introduced since the Industrial Revolution, the primary sector, such as the agriculture, has always been characterized by tradition in the productive process, with a lower degree of innovations, and such innovations have predominantly been incremental, hardly ever bringing profound changes to the production. However, the last few decades have shown that the adoption and the development of innovations is gathering momentum with ever increasing impact on the productive efficiency of the bovine sector and the agribusiness.

Furthermore, it should be noted that in the last few decades, changes in agribusiness have been happening more and more rapidly. The markets are less local and more global than ever. Djokoto and Gidiglo (2016) suggest that value adding manufacturing subsector is as efficient as the primary production agriculture. New productive processes have been developed, allowing great increases in production and cost reduction. It is possible also see that products are undergoing changes due to advances in the genetic and biological know-how and in the productive processes as well (Djokoto; Gidiglo, 2016; Carraresi et al., 2016).

The traditional view of the agribusiness where everyone focused on a production model has changed over the centuries, with room opening for a wider business vision. However, researches focused in innovation in agribusiness context are scarce. Previous studies in this topic have discussed the importance of innovation in the agribusiness (Triguero; Córcoles; Cuerva, 2013; Capitanio; Coppola; Pascucci, 2010; Siritwongwilaichat and Winger, 2004; Foltz, Barham; Kwansoo, 2000). Nevertheless, these studies are not focused on innovations and, in particular, on the bovine supply chain. The maintenance of the traditional production processes constitutes, therefore, a menace in a competitive environment. In the case of Brazil's bovine chain, as Mello (2003) tries to demonstrate, incorporating the knowledge and the innovation is essential for the competitiveness of the bovine sector as the processes of internationalization and globalization intensify.

According to the Brazilian Association of Meat Exporters (Abiec, 2016), the turnover of exports of Brazilian beef was in the \$ 5.9 billion in 2015. Despite being a high number for the sector, the value is not exceeded the collection 2014, which reached the milestone of US\$ 7.2 billion with the export of meat. The decline in this index is the result of economic problems that have negatively affected some major markets in Brazil. In the year, Hong Kong, the European Union and Egypt topped the list of countries that bought the national product in 2015.

Furthermore, until the year 2020 Brazil will be the largest producer of beef in the world, surpassing the United States, which currently occupies the first place in the ranking. Brazil is currently the second in the production world ranking. As the Confederation of Agriculture and Livestock of Brazil (Cna, 2015), the Brazilian beef exports grew by 737% in 14 years, from US\$ 779 million in 2000 to the US\$ 6.4 billion in 2014. Brazil is a world leader in external product sales, with 21% of the total. Nevertheless, despite the importance of this market for the Brazilian economy and the world, no researches has been conducted aiming to understand the past and the future challenges of the innovations needed for the Brazilian bovine chain to support this growing.

Therefore, this paper investigates the innovations taking place in Brazil's bovine sector. A survey was conducted applying qualitative research through interviews that were conducted during the Expointer fair. Expointer is considered one the most important agribusiness trade fairs in Latin America. Interviews were made with Brazilian representatives from cattlemen's associations, business associations and agribusiness supporting entities. Through the analysis of the interviews, the collection of secondary data and the literature debate, the major innovations introduced over the last two decades were identified and discussed according to the classification of innovation presented by Tidd, Bessant and Pavitt (2008): innovation in product, process, market and paradigm.

Thus, this research sought to broaden the discussions about innovation in the Brazilian bovine chain, considering its relevance to the national economy and noting that most of the studies on innovation still have focused essentially on goods and services industry. In this sense, this paper contributes to advance on discussions related to agribusiness innovation. In order to achieve this objective, the research begins by presenting the main theoretical aspects that have been debated by several researchers in this field. Then, the methodological aspects that guided the development of the work are presented. In section four, the research results are presented. Finally, the last section summarizes the main innovations observed in the Brazilian bovine chain, analyzing its aspects and its trend of evolution over time.

THEORETICAL FRAMEWORK

Innovation in agribusiness

The pillars of the studies about innovation relate to the discussions of Schumpeter (1961; 1982). Over the years, several advances and management models have been proposed in the literature, among them, Dosi (1988), Clark and Wheelwright (1992), Cooper (1994), Katz (2011), Forcellini and Rozenfeld (2006), Hansen and Birkinshaw (2007), Bessant, Lamming, Noke and Phillips (2005), Chesborough (2003), besides the neo-schumpeterian line represented by Nelson and Winter (2005), among others.

The role of innovation in the dynamics of organizations presents several differences when we compare the sector of production of industrial goods and services and agriculture and animal husbandry. In industry, a higher level of development is observed regarding innovating and a search for specificity, which leads the secondary and tertiary sectors to a greater level of differentiation among the competitors. This sector is more strongly characterized by structures of imperfect competition, where products compete strongly through extra-price mechanisms. In this environment, the greater the degree of differentiation of the product from its competitors, the less influence it will suffer from its competitors. The primary sector, on the other hand, has most of its innovations developed externally, by companies of the secondary and tertiary sector specialized in developing new products and processes for this sector. For example, farm equipment manufacturers, fertilizer manufacturers, genetics development research laboratories, among others. These innovations are rapidly disseminated across the sector, which accounts for the higher level of homogeneity among the competitors when compared with the secondary and tertiary sectors. This characteristic means that, in the majority of cases, producers operate in an environment of perfect competition, where products are perfect substitutes for each other. In this environment, the producer is susceptible to fluctuations of the market, not having autonomy to define prices. Thus, the intensification of innovations in this sector can positively impact in the sense of differentiating some products and brands, allowing gains on the value of the product on the market.

However, this does not mean that farm and livestock products have no differentiation on the present. Specificity is real in this sector, albeit in a low degree than it is in industry. This is the case, for example, of the products called 'premium'. Using new processes, producers try to develop superior quality products that can be sold in the market with margins higher than the average prices. Vineyards and olive oil producers are well known for their premium products. Another example is the production of Idaho Potatoes in the region of Bologna. The bovine sector also presents some levels of differentiation as well through innovations in the process and in the product. The Angus breed, described in this paper, is an example. Kobe Beef is another example of differentiation.

Thus, we have, on the one hand, the innovations developed by companies that produce goods and services for agriculture and animal husbandry. These innovations tend to spread across the sector generating production increase, cost reduction and increased efficiency of the agribusiness. However, they do not generate significant specificities since these innovations are adopted by many producers. On the other hand, we have the innovations developed internally to some agribusiness organization. In this case, such innovations can generate specificities as they promote differentiation from the rest of the market and generate product value.

It is noteworthy, however, that the attention given to innovations in the agribusiness and livestock sector is recent. Fortuin, Batterink and Omta (2007) affirm that most ideas about success factors in innovation are based on research conducted in high tech companies whereas investigations in the agri-food industry remain unexplored for the most part. Other evidence of research in this sector can be found in Bröring and Cloutier (2008) and Shanahan, Sporleder and Hooker (2007; 2008).

To Oaigen et al. (2011), adoption of innovations is essential if the sustainable growth of the sector is achieved. Bessant and Tidd (2009) state that the theory about innovation has been built based on technological innovation of large companies. Such a statement stresses the need to conduct research in order to understand innovations introduced in agribusiness.

Innovation in the bovine chain

Brazil's bovine sector is one of the primary sector's most relevant activities for the domestic economy. Boasting one of the largest bovine herds in the world, Brazil has a vast internal consumer market for the products derived from this chain, in addition, to be the world's largest beef exporter since 2008. Data from the Ministry of Development, Industry and Foreign Trade (2014) show that Brazil's beef export revenues reached an all-time high of 5.736 billion dollars in 2014. Due to the relevance of the bovine sector for Brazil's economy, it is of uttermost importance to understand how this sector works and develops itself.

Evidence of innovation in the bovine chain is large and diverse. Kawabata (2008) debates the increasing importance of product and process innovations in all the links of the beef industry chain, through technological diffusion and the innovative effort of some companies in this sector. Igreja et al. (2010, p.38) based on a survey conducted with key agents of the bovine chain in the State of São Paulo, observed in their analysis that "all the respondents pointed out at least one priority action in technological innovation, which shows that there is a consensus about the importance of developing the science and the technology applied to the bovine production".

Esteghamat and Abbasov (2010) analyzed the effect of hybridization or cross-breeding the Zebu breeds, concluded that the hybrid steers proved more resistant to certain diseases such as parasites, brucellosis, foot and

mouth disease (FMD) than other purebreds. Besides that, hybridization contributes to fattening, milk and meat productivity, improving the overall efficiency. Toldrá and Milagro (2011) demonstrate that recent innovations in the bovine sector are directed to the production of healthier meats and processed meat.

Innovations in beef production are being leveraged by consumption trends. The behaviour of health-conscious consumers, aware of the diet-health relationship, has increased consumer interest for the nutritional value of foods, which affects the demand for products containing functional components contributing to maintaining good health and disease prevention, a factor discussed in the work of Scollan et al. (2006).

In their analysis of milk production chain, Pacheco et al. (2012) identified that the production processes had undergone few changes. To Monteiro et al. (2012), the milk production conditions in the dairy farms are precarious and show the need for improvement in equipment, facilities and dairy cows management, and most of all, the adoption of good milking practices. The research made by Moura et al. (2010) identified some factors that are relevant to the production of milk such as the soil, water supply and the location of the dairy farms at a convenient distance from the milk processing cooperatives. Zylberberg, Oner and Zylberberg (2012) identified the positive effects of biotechnology regarding the increased economic performance of the dairy production. Thus, the technological innovations in this area may improve the milk production profitability.

MATERIALS AND METHODS

The purpose of this paper is to look into the innovations that have been introduced in Brazil's bovine chain over the last two decades according to the four types of innovation proposed by Tidd, Bessant and Pavitt (2008): innovation of product, process, position and paradigm. To the authors, product innovation refers to the "changes in the things (products/services) which an organization" offers. Process innovation refers to the "changes in the way in which the products/services are created and delivered" whereas position innovation has to do with the "changes in the context in which the products/services are introduced". And paradigm innovation refers to the "changes in the underlying mental models which frame what the organization does" (Tidd, Bessant and Pavitt, 2008, p.30).

The first step toward identifying the types of innovation introduced in Brazil's bovine sector in the last two decades was the collection of primary data through semi-structured qualitative research with important actors of this productive chain. According to Ribeiro and Milan (2007), in the semi-structured interview, there is a basic script, a set of questions which will be asked during the interview. This data was gathered during Expointer in 2013, the largest agri-business trade fair in Latin America, where agents of great relevance for Brazil's agri-business get together.

In this type of study, the researcher gathers and analyzes a comprehensive set of data in order to understand the dynamics of the phenomenon in question (Godoy, 1995). Secondary data was gathered from the sites of the Brazilian Support Service for Micro and Small Enterprises (Sebrae), Brazilian Institute of Geography and Statistics (IBGE) and Ministry of Agriculture and Ministry of Development, Industry and Foreign Trade, which provided invaluable data to substantiate the research and to understand the sector in a clear way.

An open-ended, semi-structured survey was prepared in accordance with the four types of innovation mentioned above. The interviews were conducted during the 36th edition of Expointer, in the city of Esteio, state of Rio Grande do Sul in Brazil. Expointer is an international trade fair for cattle-breeding, agricultural machines and equipment. It is considered the largest agribusiness trade fair in Latin America and as such, the meeting point for the major players of Brazil's agribusiness, with sales exceeding 3,274 billion of Reais in the last edition (about 1,450 billions of Dollars in the exchange rate for the period). The data was gathered by means of ten interviews. A national representative from each of the following actors in the Brazilian bovine chain was interviewed: The Brazilian Association of Cattle Growers 'Herd-Book Collares', the Jersey Cattle Association of RGS, Brazil's Rural Apprenticeship Service (SENAR), Brazilian Association of Hereford and Braford Cattle Growers, Angus Brazilian Association, Confederation of Trade & Business Associations of Brazil, Gir Breeders Association, Cooperativa Languiru, and Brazilian Association of Charolais Cattle Growers.

The primary data was saved for analysis by means of the content analysis technique proposed by Bardin (1977), which consists of the following stages: pre-analysis, exploration of the content gathered and the interpretation of the results. This technique can be utilized for any kind of communication between a sender and a receiver, based on the assumption that there is always a meaning behind every discourse, which can and must be unveiled. In this sense, the content analysis proposed in this paper followed the line of qualitative research put forward by Bardin (1977). It is up to the researcher, in this type of research, to grasp the full significance of the communication to which he is exposed, with sensitivity enough to perceive other meanings in the same message.

As to the secondary data, they were analyzed under the content analysis technique (Bardin, 1977; Silverman, 1995). Through this research technique, the researchers sought to interpret the data that might be useful to the achievement of an outcome with regard to the research problem, in conjunction with the primary data. According to Bardin (1977), the central idea of content analysis is to shortly present factors that are relevant to the research in question.

RESULTS AND DISCUSSION

Given its relevance and expansion capacity, the bovine sector has shown evidence of steady growth. According to Millen et al. (2011), the beef and dairy industry in Brazil has been adopting numerous innovations to improve its performance over the years. So this section describes in detail the outcome of the research carried out in the bovine sector in order to identify the types of innovation introduced in Brazil's bovine chain in the last two decades.

Product Innovation

As argue Tidd, Bessant and Pavitt (2008), product innovation refers to the changes in the product or service that an organization offers. The research demonstrates, though, that no profound changes in terms of product in Brazil's bovine sector have occurred. The changes that were introduced over the last two decades were essentially incremental.

One of the first important innovations mentioned by many of the interviewees has to do with the genetic improvement and cattle reproduction techniques, through artificial insemination. These techniques have caused improved product quality. The representative of the Braford breed cattlemen's association argues that:

Through the genetic improvement, with embryos and semen, the cattle growers can take quality leaps and improve the standard of their cattle farms. They can improve the genetics very rapidly. Whereas in the past it would take 20 or 30 years, now they can standardize a herd in 4 to 8 years on average (Representative from Braford breed cattlemen's association, 2013).

Also, the progress in the bovine sector turned it possible for a new market to come up in Brazil's bovine chain: the domestic genetics market. Since then, genetic selection and the sales for artificial reproduction purposes has become a new product, such as the case of the Braford breed, which sells in the domestic market and is beginning its expansion into the international market.

Another question put forward by the interviewees in relation to product quality improvement refers to changes taking place in the laws. Stricter laws and severe enforcement have led the cattle growers to adopt a number of animal health procedures over the last few decades. Thus the question of cattle slaughtering, meat storage and the entire process had to be adapted to comply with the laws. The entire dairy chain, milking, storage and transport, likewise, had to change to comply with the changes. However, a number of sanitary issues have been detected in the bovine chain, which restricts the possibility of entering into several international markets. The representative from the Dutch Dairy Cattle Association of Rio Grande do Sul put it this way:

The question of cattle health is becoming more important than ever. The sanitary inspectors of the government are becoming more demanding regarding inspection. We must really work hard to do comply with the sanitary regulations. Rio Grande do Sul has had FMD outbreaks, among other things. We let the diseases come into the state because we are not effective as producers. They must get started and do what they have to do, the inoculations of susceptible animals, improve the sanitary conditions. That's the only way we can get into the world market. The beef importers, when they come here, the first thing they ask is: How about the sanitary conditions of the animals? (Representative from the Dutch Dairy Cattle Association of Rio Grande do Sul, 2013).

If, on the one hand, the product quality improves due to stricter sanitary regulations, on other hand, the market forces have caused product improvements of their own. These improvements occur as a result of the organizations that utilize the inputs from the bovine chain demand the compliance with production quality standards. Alternatively, in some cases, complying with given specifications has led the producers to earn a price above the average market prices. The representative from Brazil's Association of Cattle Growers Herd Book Collares describes the situations, as follow:

Sanitary conditions have gone up a lot, and so have the meat packing industry requirements. We used to weigh the cattle while still on the hoof; steers would be sold fatter or leaner. Now the packing houses require a carcass with a termination of at least 1 through 5, at least 2 to 3 or over, and they pay a bonus for better quality meat, and better fat termination. It's their way to motivate growers to invest in artificial insemination, in breeding bulls and provide the cattle with better feed so they will achieve a better carcass termination (Representative from Brazil's Association of Cattle Growers Herd Book Collares, 2013).

Another noteworthy fact is that some breeds are preferred due to their specificity gains; they try to differentiate from the other market competitors and add value by doing so. To do that, some cattlemen's associations go out of their way to create product certification to ensure superior quality. The representative from the Angus cattle growers' association describes the certification mechanisms as follows:

He [the cattleman] must achieve certain standard at the same time, all the standards. Only Angus cattle and their young, well-built crossings with good carcass conformation meet the specifications. With these criteria we certify the good quality of this product within the partner industry until the animals reach the meat packing corrals. From the slaughter step up to the packaging step. We now have a 30 people team working in our industry... a preliminary inspection is done at the corrals and

then each animal is classified during the slaughtering process to ensure that the beef has these characteristics (Representative from the Angus cattle growers' association, 2013).

This differentiation gets highlighted in the debates on product innovation within the bovine chain. About twenty years ago there were a few meat or milk brands, which would turn the product from different producers, perfect competitors. To the point that there is differentiation through strong brands and quality control to ensure that the producers will meet the specifications, value is added to the product and the consumers' access to information and to quality is enhanced.

So the analysis relative to the innovations in the bovine chain that occurred in the 90's and the 2000 decades indicate incremental innovations directed toward the improvement of the product quality. This improvement occurred both as a result of the producers' own internal actions, as well as a result of external pressures from diverse agents such as middlemen, consumers, importers and government.

Process Innovations

According to Tidd, Bessant and Pavitt (2008, process innovation refers to the changes in the way in which the products are created and delivered. Through the research carried out, it was possible to observe that such innovations occur in the bovine chain over the last two decades. These innovations have brought about productivity gains, quality improvements, increased productive efficiency, cost reduction, among other benefits.

The analysis of the innovations within the bovine chain demonstrated the importance of developing new knowledge and the dissemination of such knowledge among the producers. Through this process, new capabilities are built up, and they make the process better over time, generating positive consequences for the chain. Some producers highlight the role played by the research entities, which contribute toward the development and the dissemination of such new capabilities. They also mention how important it is for the producers to keep searching for such knowledge as a source of innovations and for the maintenance of competitiveness. The representative of the Jersey Cattle Association of Rio Grande do Sul argue in this way:

There's been much technology work, EMBRAPA¹ has been a great help, in fact, EMBRAPA is here with us. We have here in Pelotas an institution that works very hard to improve the dairy quality, helping to develop pastures, good pastures in this region. EMBRAPA has been working on management techniques. There is lots of literature indicating the best way to

¹ Brazilian Agricultural Research Corporation (EMBRAPA) is a public company that develops scientific researches in agricultural sector in Brazil.

cultivate rotational grazing, using the pastures according to the time of year. Today we see a great concern about quality (Representative of the Jersey Cattle Association of Rio Grande do Sul, 2013).

A fundamental aspect in terms of productive process refers to the advances made in researches on genetics. Those innovations gave birth to a number of specialized companies developing animal reproduction products. This research area has evolved very rapidly over the last decades, promoting substantial gains for the quality of the product.

The evolution of insemination techniques must not be overlooked. This made possible more efficient planning and control of the cattle herds. For example, the dairy producers are interested in the birth of cows. With the development of sexed semen, the insemination companies are able to increase by 75% the probability of producing offspring of the desired sex.

Another highlight in terms of the process identified by the research are the improvements related to animal nutrition. As it is by eating suitable feeds that the animals acquire the necessary nutrients to grow, the quality of this food will directly influence the process, beef or dairy. There is a strong concern about aligning the genetics and reproductive aspects with the animal nutrition. According to the representative of the Association of Dutch Cattle Growers:

Today we are working on reproduction and nutrition together. ... Generally speaking, the first thing that the professional who takes care of the nutrition on a cattle farm asks is: Who is doing the reproducing for you? I want to get in touch with him (Representative from the Dutch Dairy Cattle Association of Rio Grande do Sul, 2013).

The interviewees mentioned the use of herbicides as another important innovation since they made it unnecessary to plow the land. Another relevant point in the use of land was the shift to the utilization of perennial pastures. These pastures need not be sowed every year, reducing the production costs. A representative from Brazil's Rural Apprenticeship Service (SENAR) put it this way:

Another important thing that happened on the dairy farms is the use of perennial pastures because they do not have to be sowed every year. There are winter pastures and summer pastures. Every year you've got to prepare the soil, buy the seeds. Perennial pastures cut down costs. Some dairy farms have been using their pastures for 18 years. They sowed the land 18 years ago and maintain the pastures through mechanization management (Representative from Brazil's Rural Apprenticeship Service - SENAR, 2013).

In reference to the dairy production, the sanitary question has been a core problem, as we previously mentioned. In this sense, innovations to the productive process have occurred in order to ensure the improvement of the product quality. The question of using mechanized milking equipment, for example, has been central and contributes significantly to the reduction of the milk contamination. Besides, the mechanization decreases the need for labor, cutting down the production costs.

In the old days, it was hard for a woman to milk cows. How could she carry a milk can holding thirty, fifty liters of milk? Nowadays, she can do that easily because there is no physical effort. She just has to attach the milk cups, and that's it. The equipment has helped a lot; it has evolved a lot too. I remember that only a handful of dairy producer had milk cooling equipment. They used to have a freezer, a refrigerator. It was very complicated back then to talk about quality. Not anymore. The milking equipment is electronic. It tells you how much milk the cow produced. If there is an inflammatory cell being formed, there are robots that do the milking without human presence. These things are changing the dairy farming business (Representative from Brazil's Rural Apprenticeship Service - SENAR, 2013).

Another point identified in the research is the professionalization of the bovine chain management. For a long time, the focus was strictly on the production, with little attention given to the management and the planning. However, this way of thinking is changing too. The representative from the Dutch Cattle Growers' Association of Rio Grande do Sul put it this way:

And what is becoming of the producer himself? He is becoming more professional, got it? Becoming more organized. The producers either become professionals or get left behind. Just like in any other segment, if you stand still, you go out of business (Representative from the Dutch Dairy Cattle Association of Rio Grande do Sul, 2013).

The animal's slaughter age has been mentioned as another important innovation. Changes in the productive process permitted lowering the slaughter age from five years down to twenty-four months, which ensures a better meat quality. In addition to that, the reduction of the land size created the need for the development of new techniques for raising cattle in smaller spaces. This change has significantly increased the productivity per hectare. These two factors combined have ensured efficiency gains in the production process. The president of the CACB describes this transition as follows:

We used to have a lot of beef from animals over five years of age. How would you tell the good producer from the bad one in the old days? The one who would sell a 600 kilos steer, 620 kilos, my grandpapa would say. Less than that would be bad. It had changed. Independently of the breed, the first thing would be young meat, that's the difference. The second thing that has made the beef producer to go further, the businessman, is the reduction of the areas. [...] the generations have a lot of children, the properties are divided, get smaller. Therefore, they have to be more efficient. My mother inherited one-third of the range my grandpa had. We produce a lot more now than we did when we had the whole range, why? Because we are better than he is? No, because the market demands efficiency. The greater change in the market was for the consumer, from then on we planted the rest, competition grows fiercer and fiercer (Representative from Confederation of Commercial and Business Associations of Brazil, 2013).

A number of innovations have occurred over the last two decades, bringing about significant gains for Brazil's bovine chain. These advances permitted productivity increases, efficiency gains, cost reduction and significant improvements to the product quality. All of that is happening in a market that is becoming more dynamic and more competitive than ever, a market where the producers must adopt a more professional stance for their businesses, as we will see in the next section.

Position Innovations

Tidd, Bessant and Pavitt (2008) define position innovation as changes in the context in which the products/services are introduced. These innovations are related to the position that the product holds in the market, either through the process of internationalization, or through changes in the direction that the internal consumer market is taking.

The last two decades represented significant changes in the market position for many producers. To understand the forces that have brought about the position innovations within the bovine chain during this period, we should understand the macroeconomics changes of this period. The first fact that has to be noted is the economic openness of the 1990's, which promoted a great increase in the competition, generating profound changes in the market dynamics. From then on, the concern with quality becomes a necessity. The CACB president describes this period, as follows:

The biggest evolution in our area was the evolution in the market. In my time, there was no "product substitute". This thing surfaced in the post-Collor era. In the old days, we would place a product on the shelf and the consumer had to buy it. And that was it. Nowadays, if you don't have [good] quality, you don't get in the market (Representative from Confederation of Commercial and Business Associations of Brazil, 2013).

It is in this context, specificity gains and position innovations enable the reorganization of a market, which has become a lot more dynamic and unstable. One of the consequences of this process is that the traditional cattle farmer, who used to perform a number of steps within the bovine chain, loses his ground. Achieving increased efficiency depends on increasing the specialization, which occurs more rapidly as the different phases of a productive chain are divided. Likewise, it was observed that the producers have to become more qualified. Now producers need to have a wider business vision, not only a producer's vision. CACB president highlighted this question:

We used to produce right from the beginning to the end of the product. Now, there are specialized people for each phase of the process. As a result, you figure: 'why should I sell to you when I can produce?'. This is the traditional cattle farmer's theory. But you achieve results depending on the way you do things. If I do everything, I won't get the same results as you do. Then you get someone who's good at doing something. One thing's changed a lot, even though the farmers, the cattle farmers, still have a lower education degree, they are being trained and groomed for the market, because in the agribusiness that thing doesn't exist anymore (Representative from Confederation of Commercial and Business Associations of Brazil, 2013).

It is in this scenario that we should understand the position innovations that occurred in the bovine sector. With respect to the production of meat, the domestic market possesses an enormous relevance due to its size. Additionally, the increasing buying power of the lower classes has permitted the increase of the beef consumption. Yet, it should not underrate the role of growing export sales for this sector, especially over the last few years. There used to be diverse sanitary restrictions that precluded the sale of beef to international markets, but a number of innovations in the productive process have made it possible to break into new markets since many of the international standards are now being met. However, some of the interviewees have mentioned the large unexplored potential existing in international markets because Brazilian product does not meet some of international quality and sanitary standards.

Another important position innovation refers to the expansion of the bovine genetic market of Rio Grande do Sul State into other regions of the country. Whereas Brazil used to be an importer of this product, now the market is internally consolidating and expanding with prospects of becoming an exporter. This is what the representative of the Brazilian Association of Hereford and Braford Cattle Growers argue:

Speaking of breeds, for the Braford breed, 20 years ago the differences would be as follows: ... the producer's way of thinking, twenty years ago they thought about bringing genetics from other countries such as Argentina, Uruguay,

United States, Canada, Australia. Since a few years ago, due to the hard work of our Association to change this way of thinking, this is the current mentality “Brazil has good genetics and we must take it to these other countries”. This is the focus of our work (Representative from Brazilian Association of Hereford and Braford Cattle Growers, 2013).

The research has also identified a clear trend in the bovine sector toward specificity gains through product differentiation and the enhancement of brands, looking to reposition the products that used to be perfect substitutes among themselves. This movement can be understood in view of the increasing buying power of low-income social classes over the last decades. The consumers do not need to buy the lowest-priced product as much as they used to. There is an increasing demand regarding quality, which forces the producers to meet the demand. The representative from the Dutch Cattle Growers of Rio Grande do Sul describes the change as follows:

When I buy a piece of meat, I want to get quality meat. When I pick up a carton of milk, I want to know if this milk brand has had any quality issues? I want the milk that's good. High quality. Today we look for quality. I believe that in many aspects the buying power has gone up and customers are looking for quality, no matter what price they will pay for it, they will buy a quality product (Representative from the Dutch Dairy Cattle Association of Rio Grande do Sul, 2013).

The Angus breed is an example of the market repositioning through specificity gains. Angus began in 2003 a process of differentiation in a market that until then was almost nonexistent. It proposes to please the customer and their preferences in order to generate product value. Through massive investment in breed improvement and in the establishment of criteria of production, inspection, and certification by the corresponding association, product value has been achieved associated with a brand that is synonymous of superior quality. In this way the main premium brand of beef sold in Brazil has been developed, targeting a specific market niche.

As we could observe, some position innovations have occurred as a result of the internal evolution of the bovine chain itself, such as the development of the domestic genetics market and its trend for expansion to external markets. We were able to see, too, that changes in the consumer behaviour, generally caused by the higher consumer income, have led the sector to adapt to new demands for quality and differentiation, generating innovations in the positioning of diverse products, as is the case of Angus. However, the root of all these innovations cannot be overlooked: the macroeconomic changes resulting from the higher degree of economic openness of the 1990's, which drove

the bovine sector to seek a new market positioning in order to adapt to a new reality: global competition.

Paradigm Innovations

Tidd, Bessant and Pavitt (2008, p.30) define paradigm innovation as “changes in the underlying mental models which frame what the organization does”. It is, therefore, a more radical change, a change that significantly alters a product, process, or the market orientation established until then.

What this research was able to identify is that a series of innovations occurred in the bovine chain over the last two decades, as it was stressed in the previous sections. However, those innovations were essentially incremental and had not been consolidated as a clearly understood paradigm innovation. For this reason, no paradigm innovation has been identified as having significantly altered the structure of the mental models of the cattle business since the 1990's.

To sum it up, we have verified that regarding product, a number of innovations have occurred, and these innovations were essentially designed to increase the quality, but none of them brought about a departure from the existing mental models. The essence of the products is still the same, with isolated and incremental changes added to it. In terms of process, equally, we have observed some innovations designed to improve the product quality, efficiency gains and cost reduction. Once more, however, we cannot pinpoint any of these innovations as paradigmatic.

Among all the process changes identified by the interviewees, the genetic manipulation for reproduction purposes was described as having the greatest impact on the productive process of the bovine chain. Nonetheless, despite the relevance of this innovation, it does not seem reasonable to us to pinpoint it as an innovation that has generated structural changes in the bovine sector. By the same token, despite important position innovations that have altered the dynamics of the bovine chain, as previously mentioned, we cannot classify them as paradigm innovations.

Even so, the bovine sector seems to be moving toward some paradigm innovations. In the first place, the relevance of the genetic research can significantly change the structure of the bovine chain on the medium run. In addition, the appearance of meat brands and the recent trend toward premium meats represent a strong change about the commodity model predominant until then. It must be noted, however, that this position innovation is still incipient. But it may prove a paradigm innovation in the future and change the logic of the way the bovine chain operates. In short, Table 1 presents a summary of the major innovations in the bovine chain from the period in question.

On the whole, we could verify a growing trend toward the insertion of the bovine chain into the internationally-practised quality standards. Besides

the evolution has been taking place and the professionalization of the production seems to be, according to the producers, mandatory for a sector of this size and with this relevance to the economy of Brazil.

Table 1. Major innovations in the Brazilian bovine chain

Product Innovation	<ul style="list-style-type: none"> • Genetics market; • Artificial insemination (quality increment); • Innovations to adapt to the new laws/regulations (quality increment); • Innovations to meet the demand of the market (quality increment); • Product differentiation (Premium products).
Process Innovation	<ul style="list-style-type: none"> • Dissemination of know-how – increased producers' capacity; • Genetics and reproduction; • Nutrition; • Use of herbicides – enabled the utilization of perennial pastures; • Mechanization of the milking process – sanitary improvement and reduction of labour costs; • Professionalization of the business management; • Decreased slaughter age; • Reduced land usage – new techniques increased the productivity per hectare.
Position Innovation	<ul style="list-style-type: none"> • Repositioning as a result of the 1990's economic openness; • Increased per capita income in Brazil – expansion of the domestic market; • Increased export sales – some restrictions still in force due to subsidies and the quality of the Brazilian bovine products; • Sector repositions itself. No longer an importer of genetics, but a producer for the domestic market and aspiring to become an exporter; • Exploration of new market niches – differentiation arising from the specificity gains of some products; • Increased buying capacity of classes C, D and E – customers less worried about the 'price' criterion and increased demand for the quality criterion.
Paradigm Innovations	<ul style="list-style-type: none"> • Among innovations occurred in the last two decades the Genetics and the consequent reproduction manipulation, in addition to the development of premium products arising from the process of differentiation, have been considered the innovations that contributed the most to alter the chain structure. Although they are potentially paradigmatic in the medium run, none of the innovations highlighted above can be considered paradigm innovations de facto until now.

Source: Developed by authors based on primary data.

CONCLUSIONS

This paper investigated the evolution of Brazil's bovine chain over the last two decades, having as its core problem the innovations that have taken place in the sector, according to the types of innovations classified by Tidd, Bessant and Pavitt (2008). Through the primary data gathered, by means of semi-structured interviews of representatives from the bovine

chain and the content analysis, in addition to the collection and analysis of secondary data, a picture was drawn showing the evolution that this sector has undergone.

The strong focus of the innovations during this period was product quality oriented. This seems to be the main bottleneck of the bovine chain. The explanation for this movement came about as a result of different forces that induced these changes. One on hand, the economic openness, which brought about considerably more competition and the insertion in a global market, leading the producers to adopt changes in order to survive in a market that, from then on, becomes highly dynamic. On the other hand, the strengthening of the laws and regulations imposing the compliance with certain standards of quality so that the products of animal origin could get to supermarket shelves.

In addition to that, the requirements of the market itself must be considered. Internally, with the increased competition and the higher per capita income, the consumers become increasingly rigorous. On the other hand, a gigantic external market will open up as the product of Brazil becomes able to meet the quality standards setup by this market. These different forces led the bovine chain to promote innovations. Those who were not able to carry them out one way or another, have been excluded from this market. After all, according to Freeman and Soete (2008, p. 457), "to fail to innovate is the same as to die".

Our findings demonstrated, therefore, a growing trend toward the insertion of the bovine chain into the internationally-practiced quality standards. The evolution has been taking place, and the professionalization of the production seems to be, according to the producers themselves, mandatory for a sector of this size and with this relevance to the economy of Brazil. However, to maintain this trajectory, the different forces prevailing in this sector will have to continue driving the chain certain on the path that promotes the growth of the markets and the increase of the product quality, permitting the increase of the capacity of generating wealth.

If, on the one hand, the external demand is already being verified, the internal demand must adapt itself to the standards of international level. To that end, the role played by the state of Rio Grande do Sul on regulating, ensuring standards of quality, cattle traceability, control of diseases, among other inspection mechanisms for the product sold in the domestic market. On the other hand, it is essential that the entities representing the beef and dairy cattle growers do their part disseminating the adoption of certain technological innovations. Doing so will elevate the production standards and incentive the adaptation of the processes to international standards. Such incentive could come in the form of technicians' visits to the cattle producing areas, offer of technical training, easy access to credit for acquiring innovations. These measures could lead this sector, from the significant position that it occupies now in Brazil's economy, to a rapid expansion.

Finally, the findings in this research are subject to some limitations that must be considered. Firstly, it should be observed that it was not possible to interview some important stakeholders and agents belonging to the Brazilian bovine supply chain due to inaccessibility issues. However, this limitation could be overcome with a set of the findings and information addressed by the interviewees included in the research and through secondary data. Moreover, our findings reflect the results obtained applying the content analysis technique. It is natural that other qualitative or even quantitative research techniques could be applied in order to analyze and identify new correlations and insights, complementing and advancing on the findings of this research. In order to advance on this relevant topic to the Brazilian economy, we recommend some potential avenues for further research. First, we recommend longitudinal studies combining qualitative and quantitative techniques debating the evolution of the type's innovations in this supply chain. Finally, it seems relevant to observe the evolution of innovations in this productive chain in comparison with the implementation of innovations in other countries with a tradition in the production of products derived from the bovine chain.

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