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Application of Technological Tool for the Development and Competitiveness of the Livestock Sector in Quindío, Colombia

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Abstract: Livestock is one of the most important productive lines of the national economy, hence the importance of analyzing its current state, regarding associativity and competitiveness as fundamental axes for increasing the productivity of the dairy sector, designing for this, a sustainable technological tool. The globalized world demands daily new, innovative, and easily accessible technologies for small producers, making them more competitive and productive. Hence, the software design, easily manageable, will gradually lead to the cattle ranchers of the municipalities of Quindío, in Colombia, appropriating tools that will increase their income. This research aims to design and apply a technological tool for producers in the livestock sector of the municipalities of Circasia, Filandia, and Salento, in the Department of Quindío, to increase their competitiveness and associativity capacity, development and competitiveness of the livestock sector in Quindío. For its analysis, the participation of the dairy producers and ranchers' associations of the municipalities of Filandia, Circasia, and Salento, of Quindío was characterized through interdisciplinary fieldwork, with structured surveys, to develop a user-friendly technological tool later. Based on this, the needs of users, associativity, and later the technological tool were designed. The application of a sustainable and easy-to-use technological tool leads to an increase in competitiveness in the livestock municipalities of Quindío while at the same time being motivated for associativity and teamwork.

Keywords: associativity, sustainability, livestock, technology, software.

哥伦比亚金迪奥畜牧业发展和竞争力技术工具的应用

摘要：畜牧业是国民经济最重要的生产线之一，因此分析其现状的重要性，将关联性和竞争力视为提高乳制品行业生产力的基本轴，为此设计一种可持续的技术工具。全球化的世界每天都需要为小生产者提供新的、创新的和易于获取的技术，使他们更具竞争力和生产力。因此，易于管理的软件设计将逐渐导致哥伦比亚金迪奥市的牧场主使用可增加收入的工具。本研究旨在为昆迪奥省菲兰迪亚, 环亚、和萨兰托市畜牧部门的生产者设计和应用一种技术工具，以提高他们的竞争力和关联能力，以及昆迪奥畜牧部门的发展和竞争力.在其分析中，昆迪奥的菲兰迪亚、切尔西亚和萨伦托市的乳制品生产商和牧场主协会的参与通过跨学科实地工作和结构化调查进行了表征，以便以后开发一种用户友好的技术工具。在此基础上，设计了用户的需求、关联性以及后来的技术工具。可持续且易于使用的技术工具的应用提高了金迪奥畜牧市的竞争力，同时激发了联想和团队合作的动力。

关键词: 关联性、可持续性、牲畜、技术、软件.

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1. Introduction

The geographical, social, and economic composition of Colombia has a broad rural component: 94% of the country belongs to the countryside, and 32% of the population lives there. The majority of Colombians that make up this population have micro-farms or small properties, but their productivity rates are not very good. The entry into force of free trade agreements and the disappearance of tariff barriers leads the country's agricultural products to compete with products that have been grown through the use of techniques and technologies that make them more productive, offering better prices [1].

The new economic, social and environmental reality forces the productive sectors to take on the challenge of designing and structuring new business models, enabling them to achieve higher levels of productivity, lower costs, and seek integration between small, medium, and large producers. That is why associativity becomes an efficient model for the benefit of farmers in the field to improve their access to new markets, achieve the formalization of work, and develop business skills. Without losing sight of the origin of associativity in the sector, the term is closely linked to family farming. If we 'associate' this word with the demands of today's world, it is clear that agricultural activity is more than obliged to seek new alternatives for a business organization allowing for greater growth and development [2].

Livestock is one of the most important productive lines of the national economy, hence the importance of analyzing its current state, considering associativity and competitiveness as fundamental axes for increasing the sector's productivity.

Aspects that affect competitiveness in the department of Quindío are:

- Low levels of business density, with processes of little economic complexity.
- Low investment in STI and R&D, limiting the generation of high added-value products.
- Limited human talent in generating added value (high-level human talent, in the business fabric).
- Weakness in value chains.
- Low levels of technical and technological capacity, which translates into lower productivity and business competitiveness.
- High transaction costs of internal and external goods for logistics.
- High tax expenses [3].

Associativity is an essential factor in referring to the business notion under solitary economy. The main source of income in Colombia is sustained from the field. The country requires the consolidation of strategies that enhance its competitiveness within the current development framework, based on the vision of solidarity that accompanies the orange economy processes at the regional level, where values such as associativity are the basis for the generation of income and employment.

Currently, the dairy sector lacks accessible and easy-to-handle technological tools at the regional and national levels. This situation has resulted in the design of friendly tools and software so that anyone can manipulate and appropriate it, leading to associations, producers, and consumers getting into new technology, allowing them to make their own decisions and even manage their properties from this application.

1.1. Associativity

The concept of associativity arises as a response to economic paradigms, including the liberation of markets among their postulates. In turn, it flourishes as a cooperation mechanism that seeks a common objective. It seems to be a key in the construction of the territory, and it translates into a transversal axis to advance towards processes of territorial development.

Associativity between whom? The empirical answer seems to be: between civil society and local political society, that is, between their actors and institutions. Indeed, in order to overcome the deficiencies of the centralized, vertical, and unconsulted development inducing procedures, typical of the past, it will be necessary to invent procedures that make the territorial community itself the endogenous agent of change, transforming it into a regional collective subject [4], [5].

Associativity is a community attribute that encompasses aspects of social life such as social networks, norms and mutual trust, which are more effective ways to achieve common goals and objectives of the individuals who enjoy this social capital [5], [6].

From the Colombian normative perspective, associativity is considered one of the guiding principles of Territorial Organization in the new Organic Law of Territorial Organization LOOT. Under this precept, the territorial organization will promote the formation of associations between territorial entities and instances of territorial integration to produce economies of scale, generate synergies and competitive alliances, and achieve common economic and territorial development objectives [7].

"Associativity is an instrument of social governance, but it is also an inspiration with its own meaning." From the multiple forms of associativity, people put their dimension of active citizens into practice in their effort to be subjects and beneficiaries [8].

1.2. Competitiveness

Competitiveness is the ability to make quality economic decisions that generate value and produce good results in the globalized economy (self-development, non-standard and inclusive).

It is a specific regional scenario; competitiveness is the capacity that its inhabitants have (individually and

collectively, from the different areas of their activity in society) to identify, create and take advantage, with the support of the state, for the benefit of all and in a permanent and sustainable way, economic advantages of a global market, creating added value, from the use and improvement of its tangible assets (natural resources and environmental capital) and intangibles (human and social capital, culture and institutions, knowledge society) [9].

The level of the country's competitiveness in the international arena, like that of the Coffee Region, does not reflect an optimal panorama. Many challenges must be posed to respond to the demands of the new international economic context and the need to produce results in satisfying needs, using opportunities, and fulfilling the aspirations of the inhabitants of this area of the country.

According to the study carried out by [10], based on the Human Development Report for the Coffee Region, the economy of this territory reduced the dynamics that characterized it in the first half of the last century. It has been a considerable period away from the performance of the economies of Bogotá, Cundinamarca, and other comparable departments.

However, the continuous population migration at the urban level has led to new dynamics as a favorable starting point in this conceptual category. This is evident in the "conurbation" between the main cities of the ecoregion, generating the dispersion of productive activities converted into value chains (cluster). The growth and economic positioning of the cities have resulted in an environment conducive to competitiveness. In the same way, it is important to highlight that this territory has experienced a big change in recent years concerning equipment systems, public transport, and the access roads system. These factors have structured axes for the constitution of this urban conglomerate, but these conurbation processes have not had the respective decentralization process.

Figure 1 shows a general diagram of the main elements of competitiveness.

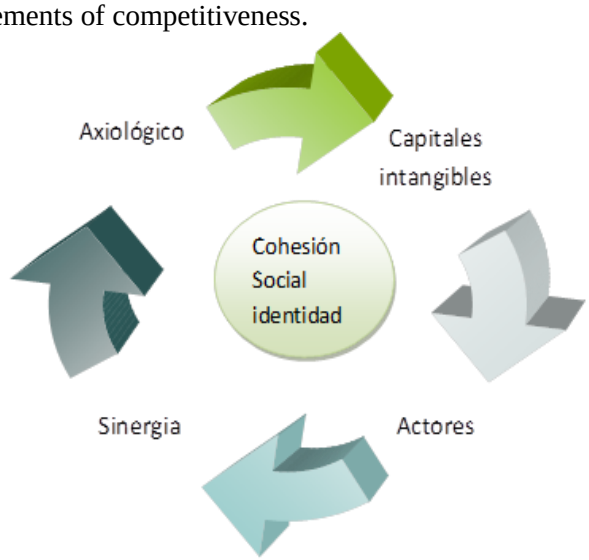

Fig. 1 Structuring elements of competitiveness

In this order of ideas, the research project was an opportunity to insert a strategic construction between the field, technology, and the human in the dynamics of the department's livestock sector. These changes facilitated the identification of those obstacles to dairy production in El Quindío, identifying the needs of the population from an economic perspective, and recognizing the incidence of imaginaries that revolve around milking practices from the generational splicing that have accompanied this activity and determine family cohesion and the conditions for the production.

These ideas were implemented under an interdisciplinary approach between the Faculty of Agro-Industrial Sciences and the Faculty of Human Sciences and Fine Arts. This approach provided an understanding of the dairy context in the department from a human and productive scope according to the production parameters and by facilitating the management of the different herds owned by each member of the associations through a digital tool.

Through this project, the relevance of the execution of initiatives that integrate elements from technology is claimed, highlighting the activity carried out in the field and promoting the coverage capacity of associations and other solidarity companies in the territory.

Currently, the agricultural producer of the dairy sector has been participating in work stoppages of the peasant sector because their agricultural activities are not profitable. After all, many factors influence: the purchase of inputs, the value of freight, the condition of national roads, and treaties of free trade. When they propose alternatives for solving this situation, associativity tries to be that exit. It helps enter competitive markets where the final consumer is more demanding every day, demands higher quality products, and protects the environment. For a producer that does not work together to meet these characteristics, it is very difficult, almost impossible, to provide this type of market.

Once the characteristics that influence the livestock associations in these municipalities are explored and identified in terms of their history and evolution in the country, it is also time to evaluate the existing models, make the necessary adjustments in normative and public policy, and develop a technological tool (software) that will be easy to apply and highly useful for the beneficiaries. In view of the above, the purpose of this research is to design and apply a technological tool for producers in the livestock sector of the municipalities of Circasia, Filandia, and Salento so that their practices increase their level of associativity and competitiveness.

2. Materials and Methods

2.1. Methodological Design

The research project falls under the exploratory-descriptive line, according to [11]. This type of research "aims to examine a topic or research problem little studied about which there are many doubts or which has not been addressed before" [11: 115]. In the case of descriptive research, [12] states that "it seeks to specify the properties, characteristics, and profiles of people, groups, communities, processes, objects or any other phenomenon that is subjected to an analysis". From the proposed context, relationships between the components and the phenomenon can be shown to explain its particularities later.

The research raises an exploratory-descriptive scope since it seeks to strengthen the associativity and competitiveness of the livestock sector in the Municipalities of Filandia and Circasia, territories recognized for their agricultural trajectory in the Department of Quindío. To meet this objective, it is essential to know the realities of this productive sector from the subjects, identify the strengths and improvement options to promote collective participation scenarios that improve the sector's production, generate networks, and use sustainable technological tools.

Referring to the objectives set out in the research, the approach of the project is mixed since it seeks to integrate the qualitative and quantitative methodology to achieve a comprehensive analysis of the object of study.

According to [13], research with a mixed approach represents the highest degree of integration or combination between qualitative and quantitative approaches to argue the above clearly. Both are intermixed or combined throughout the research process, or, at least, in most of its stages, it adds complexity to the study design; but considers all the advantages of each approach [14], [15].

From the qualitative point of view, it seeks to characterize the livestock sector of the Municipalities of Circasia and Filandia, particularly of two Associations present in this geographical area, through social research techniques such as participant observation, social mapping, rapid territorial diagnosis, and semi-structured interviews. It seeks to read reality with a direct approach to the population, obtaining the qualities of the reality studied.

The design of a sustainable technological tool is proposed for which the statistical analysis statgraphics and Excel are used as quantitative approach techniques. The mixed approach is extremely relevant within the research process considering the above. It allows an objective description of the analyzed results and a detailed and complete understanding, enriching the results [16], [17].

2.2. Population and Sample

The survey population includes three livestock associations: 30 respondents representing APROLACIR (Association of Circasia milk producers) from Circasia, 10 respondents from ASOPROAGRO, Filandia, and 10 respondents from Salento.

2.3. Phases of the Project

- Designing an instrument for information gathering.
- Collecting information from the associations in the municipalities of Circasia, Filandia, and Salento, in the department of Quindío through interviews and participant observation by visiting the properties of each producer.
- Elaboration of the specific technological tool for the livestock associations of the municipalities. Creation of a specialized tool according to the needs of the associations.
- Developing training processes in the different components of associativity, competitiveness, and use of the technological tool.

3. Results and Discussion

3.1. Territorial Diagnosis from Dairy Producers

The participatory territorial diagnosis constitutes a powerful methodological tool for research and intervention processes in the social sciences, particularly in social work. It allows a direct approach with those realities of the communities that are gestated in daily life. In turn, it creates a close link with the feelings, knowledge, and needs of the population groups with whom we work. In addition to this, it is a fundamental strategy for planning regional and sustainable development. As a social construct, it allows generating spaces for consultation and citizen participation, reasons that expose the importance of privileging this type of methodologies in the fieldwork carried out with associations [18], [19].

Therefore, the purpose of the territorial diagnosis was to strengthen the importance of associativity and competitiveness in APROLACIR and ASOPROAGRO. Although the interview was the central source of information to create the technological tool, this would not have been possible without the participatory territorial diagnosis that directly and indirectly linked the associates and their families. This investigative technique was carried out through three methodological stages.

First stage: Initial observation. The objectives and logistics of the research developed by the University of Quindío were socialized in the first field trips. Subsequently, the areas of interaction between the associations and the producer population were recognized through a direct approach to the properties. The actors, in other words, the producers, were the

starting point of this intervention since they are the ones who increase, decrease, accept and change the interactions with the territory traditionally defined. Second stage: Dialogue with the actors [20]. The lack of organization directly affects both associations to the extent that there is an absence of communication, moderately acceptable commitment on the part of the producers, and no continuity of the board of directors. Third stage: Search for consensus. The immersion in the field made it easier for the associates of APROLACIR, ASOPROAGRO, and the Salento association to consider organizing and associating under the cooperative model, allowing them to carry out effective activities that lead to economic reactivation and improvement of competitiveness [21].

3.2. Socio-Productive Characterization of the Dairy Community

Five direct constructs were determined through the semi-structured survey, as shown in Figure 2, where the social construct allowed observing the family dynamics in both associations. The results showed that 50% of the respondents were part of a nuclear family composed of four members, and 30% had three family members. In addition, 20% of the families were married couples. 60% play the role of father-provider, 20% mother-provider, reflecting the change in the role of women and their actions in the production chain, and the remaining 20% play the role of child-provider, evidencing a future generational change, significant for the livestock sector. According to the findings, 50% of the producers would improve the board of directors of the associations, making it a more organized one, with greater commitment and continuity. At the same time, 30% consider it important to improve and expand the technology of the producing plant, and 20% believe that greater participation is necessary on the part of all the members of the associations. 100% consider it important that the members of their families join the association, considering that teamwork would benefit everyone and improve the family economy.

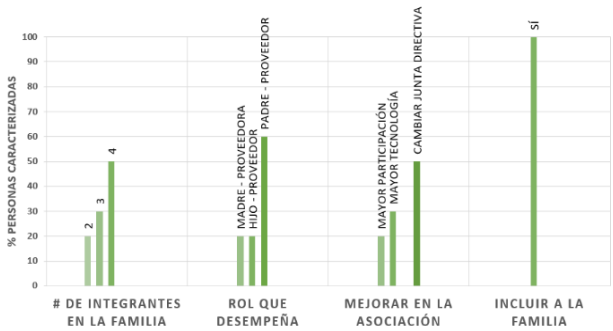

Fig. 2 Social construct analysis of dairy producers

3.3. Design and Application of the Technological Tool

Figure 3 shows how the technological tool was designed, which is made up of six sections: farm data, inventories, dairy register, control, paddocks, and accounting, in such a way that it is easier to use by all and each of the users. Said software or technological tool seeks that the small dairy producer of Filandia, Circasia, and Salento can have access to the system proper management, which allows them to carry out an independent control over everything produced on their farms.

Fig. 3 Design of the technological tool

The technological tool design obeys the characterization made to the users, who demand an application at the computer level or even an App. This tool allows them to trace their properties without having to incur additional expenses that the same milk or meat production does not allow them to cover. As a result, the same associates of the three municipalities raised their needs. They implemented a technological tool, which increases the competitiveness of the livestock sector since transcendental processes are optimized for the development of each of their properties while strengthening associativity and leadership, showing the ease of access to new computer technologies.

The enthusiasm with what each of the users learns from the tool stands out, becoming an added value proposition for each dairy product that they wish to produce at a certain moment.

As it could be perceived, the producers can constantly update the information in the Excel (2016) software designed, and they are automatically reflected in the mobile, tablet, or computer application.

For the owners or users of the properties, Figure 4 shows how the registration of their respective farms should be done. The application is easy to manipulate. Each can transcribe the information and characterization of their properties concerning the municipality, name of the village, the livestock age, gender, etc.

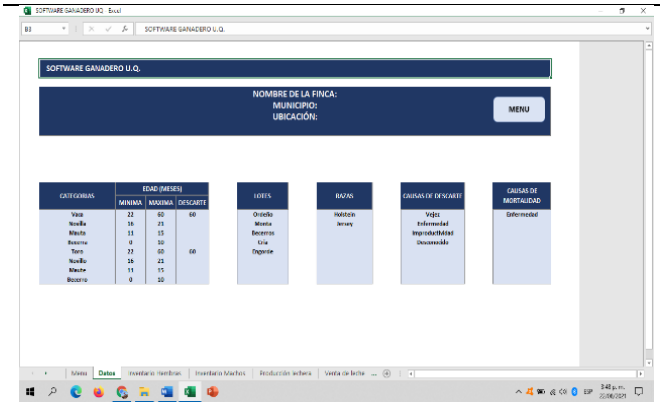

Fig. 4 Characterization of each farm

The corresponding training was carried out for each tab that is part of the technological tool. The users feel satisfied because, as shown in Figure 5, the acquisition and characterization of their properties is made simple.

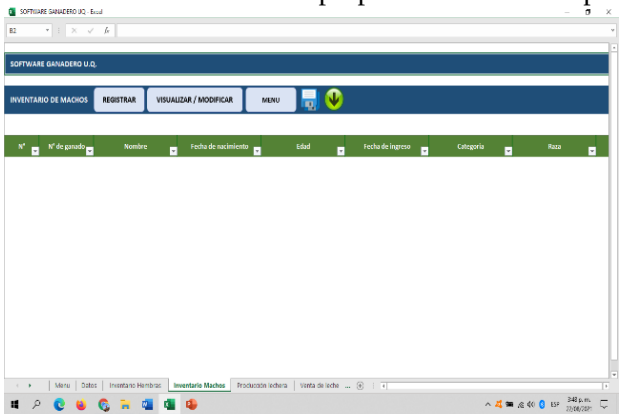

Fig. 5 Inventory of livestock farms

At all times, the user controls the technological tool and can modify the data without any inconvenience.

Each owner is autonomous to carry out the dairy or meat production on their property, as shown in Figure 6.

Fig. 6 Destination of the farms: milk or meat

Since there are users who only use milk or meat or even with dual purposes, the tool facilitates this differentiation, making it possible to have more effective control of the characterization.

For the users of the three municipalities, as shown in Figure 7, they can establish the gender of the cattle, making a more effective follow-up, as this has led to a plan for the growth of the dairy, meat, or double-purpose herd.

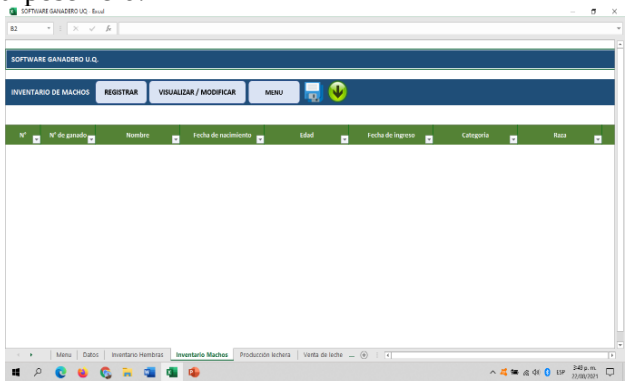

Fig. 7 Herd characterization by gender

For farms destined for the sale of milk, the technological tool is user-friendly, making this control more effective and, thus, subsequently determining the profit generated (Figure 8).

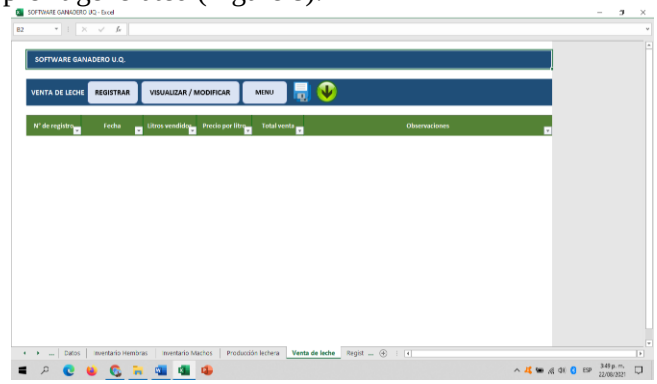

Fig. 8 Sale of milk

The purchase of agricultural inputs is one of the most important factors when determining the usefulness of each livestock farm. Therefore, in Figure 9, the tab is shown, in which each user can take their control.

Regarding the participatory territorial diagnosis: a fabric from the producers allowed to account how associativity is a fundamental pillar in rural areas. It is relevant to state that the associativity present in the agricultural sector must be based on two characteristics.

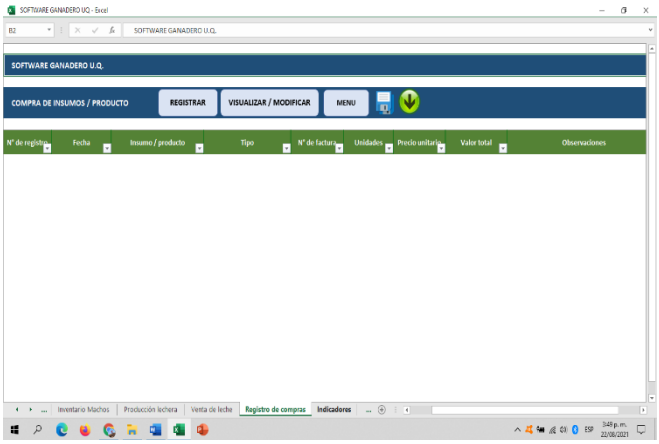

Fig. 9 Agricultural inputs

On the one hand, the economic associativity between producers, who are organized thanks to the creation of different dairy associations in favor of having representation, voice, and vote in the different instances of municipal (Circasia - Filandia), departmental (Quindío), and national order (Colombia). On the other hand, the livestock sector represents a commercial activity where jobs and income diversification are generated. A territorial association (APROLACIR, ASOPROAGRO, and the Salento association) reflects transparency for the public and private institutions, ensures common interests and participation in projects that forge technological advancement in the field, and transfers knowledge between generations.

As a social group, rural families converge in transformation processes. Owing to the kinship relationship, they have the initiative to be associated by the generations; that is, based on the age of each household member, they distribute responsibilities in the production chain. However, one of the most important variables is the lack of information on the R + D + I processes. Neither the associations nor the producers can invest in acquiring knowledge that allows them to improve the final product, without opportunities to increase quality and the income of the same, this leads to reflect and take into account the current situation of the field on the high costs and expenses that dairy production implies.

Although 70% of the associates understand the GPGs, the actions involved in the production of the other 30% of the associates significantly damage the final product; They ignore the fact of implementing the GMP, causing cross-contamination in each of the links, for example, they do not take into account taking the cow half an hour before for milking, the cleaning of the milk bucket is minimal and even nil, damaging the level of acidity and therefore damaging the entire dairy chain at the time of unifying production in the plant, likewise, at the time of dairy transformation they do not have the necessary biosecurity implements to be in the production plant.

4. Conclusion

Understanding dairy production in the department of Quindío implied a racking through the population's imaginary from the milking practices that emerge in the middle of the generational splicing and prevent the consolidation of the adequate processes for obtaining milk, according to the parameters of quality, in addition to dimensioning the impact of the notions that revolve around work under the solidarity company modality, where associativity is a determining factor in developing the region and the associates' households.

The design of the new technological tool becomes a scientific novelty, which is easily appropriate by dairy producers in the Department of Quindío. It results in associative processes that increase productivity and competitiveness since they do not require advanced computer systems knowledge. On the contrary, they make it friendly and easily accessible; This leads the designed software to become an easily reproducible pilot model with other types of production processes. The technology becomes a tool that facilitates the cattle herd management from the accounting and statistical exercise to identify those failures in the production chain from the expenses and profits that the maintenance of the cattle and the milking days entails. Similarly, the new application as a digital tool boosts competitiveness. It allows the conception of digital transformation at the service of the needs of the context. In this case, agriculture, becoming an important input for the small dairy producer and even other agro-industrial processes, know and manage producers' own environment, the comprehensive analysis and operation of their cattle herd, until they determine if it is profitable or not.

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