RESEARCH PAPER

An ERP implementation on a beekeeping and honey value chain: A decentralized and digital approach

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ABSTRACT

Goal: This research represents a case study on the selection and implementation of ERP systems in the beekeeping and honey production sector, developing a decentralized and digital system accessible to every stakeholder in a cooperative based in the province of Buenos Aires, Argentina.

Methodology: The work develops an in-depth analysis of the beekeeping activities and how farmers participate and interact with the cooperative. This enables to distinguish the main features and specifications that an ERP system must have to give proper support to the business functions within the cooperative.

Results: This implementation made it possible to make the production process more flexible, improve the traceability of production batches, and reduce costs in the business operation.

Limitations: To generalize the results, other experiences from similar organizations should be incorporated. In addition, it would be convenient to reassess the situation when the implementation is fully developed, since this article presents the implementation of essential and critic modules for the operation of the organization.

Practical implications: A special feature of this study is that the organization is structured as a cooperative, then each producer is a stakeholder in the system meaning that the decision-making processes are decentralized and transparent to each stakeholder.

Originality: This study represents a novel development in using cloud and digital technologies to leverage and foster horizontal organizations such as cooperatives. Digitalization enables to share the information and decisions made by each of the stakeholders, something that strengthens the main purpose of cooperatives. As far as we know, there are no previous studies on developing ERP systems for an agricultural cooperative.

Key words: Enterprise Resource Planning; Decentralized Decision-Making Process; Value Chain; Beekeeping; Honey; Cooperative; Cloud technologies.

1. INTRODUCTION

An Enterprise Resource Planning System (ERP) allows to guide all the decision processes of an organization towards its objectives, that is, it directs and aligns all decisions towards its strategic objectives (Wei et al. 2005; Schlichter et al. 2021; Bueno et al. 2022). To achieve this alignment, and enhance the rational use of the organization's resources, ERP systems manage the company in

is customary, but in activities related to agriculture, this type of implementations is actually global terms, that is, seeing the organization as a whole (Bjelland & Haddara 2018). The different business functions with their corresponding decision processes are linked to the global ERP as subsystems. Then, the ERP integrates in a single system all the subsystems of the company (Vollmann et al. 2005; Costa et al. 2015; Junior et al. 2018; Tavana et al. 2020).

In industrial systems such as manufacturing processes or process plants, the use of ERP systems scarce (Ali & Miller 2017; Junior et al. 2019). That is why in this work it is proposed to present a case study based on the implementation of an ERP system in the beekeeping industry, encompassing all the activities from the first stages of the process such as the collection of honey to the final sale of the product. The honey production sector represents a very significant economic activity for the Argentine agriculture production, since Argentina is the third world producer and the second world exporter of honey, surpassed only by China, producing between 60 and 75

thousand tons of honey per year (https://www.trademap.org/). In addition, a particularity of this agricultural activity is the conformation of the sector, where there is a large presence of small and medium farmers. According to the National Service for Agri-food Health and Quality (SENASA), Argentina has more than 23,000 registered beekeepers managing 2.5 million beehives. Of the total production, 95% is exported mainly to the United States, Germany and Japan.

At the same time, it is important to understand the relevance of the beekeeping activity: on the one hand, the income of the producers that partly mobilize the commercial activity of many localities in the country and, on the other hand, the need to have bee colonies that, through pollination, allows to increase agricultural production and development of the local ecology. Specifically, this work will address a case of beekeeping production in the south-western region of the province of Buenos Aires, which represents approximately 25% of the territory of the province of Buenos Aires (over 75,000 km2). In this region there are approximately 500 beekeepers with a total of 200,000 beehives, which represent 8% of the national production. It should be noted that for 85% of beekeepers this activity represents the main income. Furthermore, the impact of the beekeeping activity on the regional economies is very important, because most producers are close to small towns, where there is no great diversification in the economic activity. In addition, in many cases, beekeeping is the main activity in these rural communities.

This work proposes to address the implementation of a decentralized decision-making system in a very traditional production area such as honey production. In addition, the case study is based on a cooperative type organization. In cooperatives, each of the workers is also the owner of the organization, so they participate directly in the distribution of profits of the organization. This type of organization is common in rural activities, especially in the case of small-scale rural producers. In a cooperative organization, each partner can discuss and solve the different problems that arise in an equitable way with the rest of the partners, that is, they all have the same power and authority. In this case, the cooperative is made up of rural honey producers from the south of the province of Buenos Aires. This Cooperative brings together all the producers in the region, and allows to achieve synergies when developing beehives or generating economies of scale when purchasing from suppliers. In recent years, the Cooperative allows the processing and refining of final products, improving the ability to add value to the honey produced, managing in many cases product packaging and dispatching for direct exportation. These enormous advantages to which small producers can access entail an increasing complexity in the organization and coordination of activities. These complexities lie in the fact that the activity of the different producers is distributed, with distances of more than 300 km among them in some cases, and the production process consists of many stages that involve relatively simple and manual operations. Therefore, generating reports and establishing control criteria is really complex.

All this has led to imbalances within the cooperative in terms of the decision-making process, with a greater weight of decisions falling on those partners/producers who are geographically closer to the cooperative's industrial facilities. These imbalances are due to the fact that much of the information related to production processes is managed with physical media, which prevents distant partners/producers from being informed and consequently participating efficiently in decision-making processes. The consequences of these imbalances are a misinformation of the status of the stocks and status of customers' orders, as well as distrust within partners/producers. Therefore, it is necessary to solve this problem in decision-making taking into consideration the conditions of the case, such as great geographical dispersion of stakeholders and resources. A first step would be to design a system that allows equitable access to information among all partners/producers, even those that are geographically distanced. Then, once access to information is improved, it is necessary to provide the means for balanced decision-making processes and to respect the idiosyncrasy of the cooperative. In this sense, the following questions arise to be addressed:

How can access to the organization's information be provided to all partners/producers in an equitable manner?

How can decentralized decision processes be systematized, ensuring equitable participation for all partners/producers?

The answers to these research questions were obtained from the implementation of a digitized system for comprehensive business management, ERP. Therefore, the adoption of an ERP system should allow a transformation in the way the Cooperative is managed, handling digital information from the first stages of the process (Bjelland & Haddara 2018; Patalas-Maliszewska & Kłos 2019).

This work is organized as follows. Section 2 presents the related literature about this topic. Section 3 presents the methodology used for this study. Then, in Section 4 the situation that prompted the process of selecting and implementing an ERP system is introduced. The search and selection of the appropriate tool is set out in Section 5. The characteristics of the implementation are developed in Section 6. Finally, in Section 7 the results obtained are presented and in Section 8 the conclusions and future lines of work are detailed.

2. ERP IN AGRICULTURE ACTIVITIES AND RESEARCH GAP

The use of information technology systems in agricultural production systems has grown considerably in recent years (da Silveira et al. 2021). These technologies have produced a substantial improvement in the management and administration of the food supply chain, enhancing the traceability of products (Bhatia & Bhat 2020), improving the use of inputs for production (Junior et al. 2020) and developing the economic capacity of the processes (Junior et al. 2019a; Alva & Rojas 2022). However, ERP technologies are still insufficiently diffused among agribusiness activities, where the degree of standardization of processes and tasks is relatively low, and their digitization is even less developed. This prevents the possibility of having access to the data that is vital for ERP systems (Da Silveira et al. 2021; Bueno et al. 2020).

Based on a study carried out in Brazil, Junior et al. (2019b) conclude that one of the main difficulties in achieving extensive adoption of digital technologies in agricultural production is the lack of visibility of the production resources for decision makers. For its part, in Russia, a similar behavior is observed, where agricultural producers recognize the potential and ability to improve business performance, however, there are very large barriers to its adoption as staff are poorly trained in this regard, ERP systems are poorly adjusted to their reality and there is distrust on the part of investors (Kulikov et al. 2020). Something analogous was observed in a study carried out in Malaysia (Shukor et al. 2020), where SMEs associated with agri-food value chains were analyzed. In this study, it was identified that the use of this type of technology is almost nonexistent, and within the barriers that hinder its development, the lack of solutions well adapted to the agricultural reality and of trained personnel stand out. A different case was observed in Denmark, where 62% of the respondent farmers assured that the ERP solutions allowed to improve the indicators of their businesses (Verdouw et al. 2015).

In general terms, in the agriculture business it is not customary to adopt digital technologies for management processes and decisions (Panetto et al. 2020). This feature restricts the possibility to count with updated and validated information, which implies that decision processes become rigid and inflexible (Boshkoska et al. 2019). These difficulties generate that, within the agricultural supply chains, the decision processes are not very efficient. A key aspect is the perception of agricultural producers about this type of technology. In a study carried out in Italy, it was found that one of the main limitations for adoption is the lack of success stories in similar environments, highlighting that, in order to increase the number of adopters of digital technologies, service providers should highlight the economic advantages that such systems would provide (Annosi et al. 2019). Likewise, the adoption of digital technologies would allow the collection of data, which in certain cases can contribute to generate a future benefit from the waste generated from the operation of agricultural production, whether in the generation of energy or other value-added applications. (Belaud et al. 2019).

A common factor in the barriers identified in these articles is the lack of ERP systems adapted to the reality of typical jobs in agriculture where production is often varied at different times of the year, and inputs change as well as suppliers (Meirelles 2022). On the other hand, traditional ERP systems base their logic on the materials management activity using structures similar to MRP and MRP-II, something that is valuable for industrialized manufacturing processes, but not entirely useful for production processes based on biological principles where inputs and outputs have great variability, such as the agricultural ones (Shukor et al. 2020).

In this work, the selection and implementation process of an ERP system for a honey production cooperative is described and discussed. This case study of ERP systems in agricultural cases adds to the difficulties and barriers mentioned before, the organizational structure of the company: a cooperative. In other words, resource management and decision-making are not centralized, but each member of the cooperative has an influence in this process. Therefore, as a decision-making process, it adds complexity. That is why this work aims to make a contribution in this line of

implementing ERP systems in agricultural production systems.

3. METHODOLOGY

The objective of this work is to generate contributions to the literature on ERP systems in agricultural settings, particularly in cooperative-type associations. To this aim, a case study of an ERP implementation that was carried out in the southern part of the province of Buenos Aires, Argentina, is proposed. The methodology developed for the case study had an essentially practical-practitioner profile, where the resolution of a concrete and real problem was prioritized over its conceptual study. Although the resolution of the problem required knowledge and conceptual interpretations of its theoretical aspects, the approach is mostly empirical.

In particular, a diagnosis of the context and the initial situation of the considered cooperative was carried out. This diagnosis analyzed the main components of the cooperative's current management process, as well as the particular characteristics of each component. Also, the difficulties and complications that affected the management process of the cooperative were studied. From this analysis, the main characteristics that the ERP system to be implemented should have emerged. Also, those responsible for the management cooperative were interviewed about other characteristics that the ERP system should have. In this way, from the analysis of the situation and the interviews, the technical requirements to select the ERP system were obtained.

Once the requirements were defined, the different ERP system suppliers were contacted to inquire about their services and systems. With the technical specifications provided by the same system suppliers, a direct comparative analysis was carried out. In this case study, the comparative analysis was developed jointly with those responsible for managing the cooperative. Therefore, the system that is best adapted to the problem and relevant context was selected.

4. ORGANIZATION CONTEXT DESCRIPTION

The Cooperative is currently made up of twenty-one professionals and technicians - mostly beekeepers - many of whom, in addition to being part of the different work teams, also act as advisory promoters of the groups of beekeepers that are nucleated in a special Chamber, a civil non-profit association made up of small and medium-sized beekeeping establishments whose aim is to increase and improve the productivity, quality and competitiveness of their businesses. The purpose of the Cooperative is to provide the members with jobs and the corresponding remuneration, through their personal and direct effort, part-time or full-time, through the joint organization of the production of goods and services related to beekeeping. Together, both groups are named and presented with the acronym CAP. The location of CAP is in the south-west portion of the province of Buenos Aires in Argentina, as depicted in Figure 1.

The Cooperative develops its activities in the beekeeping market, selling inputs for beekeepers, and also on the food market, offering products derived from beekeeping.
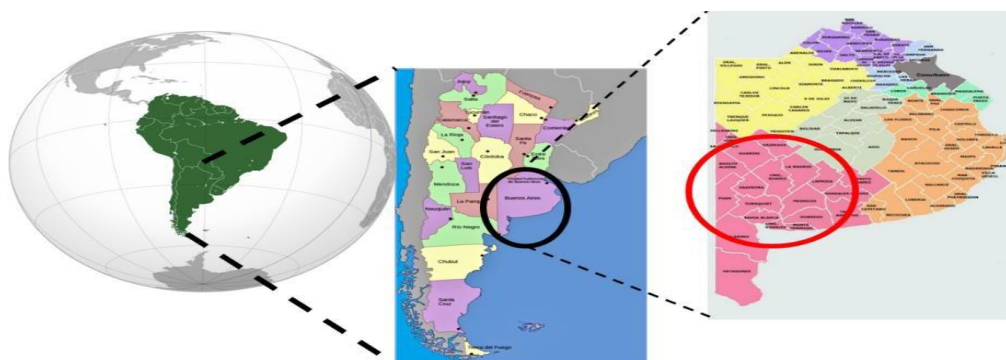

Figure 1 - Location of the Beekeeping Cooperative.

4.1 Production Planning

The production plan provides the basis for making correct use of the company's resources and fulfilling the delivery promises to customers. This planning process is carried out according to the projected sales and the availability of space in one of the headquarter facilities located in the town of Felipe Solá, since the processes of fractionation and extraction of honey cannot be developed at the same time.

The honeys present a seasonal peak between the months of March and August, notably

increasing the demand for the products in those months. To meet the demand, production quantities are planned during the month of March, when extraction activities are not carried out, and for the months after the harvest, in this way an initial stock of honeys is ensured to cover the requirements at the beginning of the season and in May production resumes to meet demand until the end of the season.

4.2 Traceability and sampling

To ensure the sale of a differential product, the Cooperative works with producers of the Chamber who do not use synthetic products in their hives and who also use a traceability system designed and implemented by the Cooperative. The traceability system takes into account the record of the different variables observed in each visit to the apiary: apiary name, date of visit, location, flowering in the surroundings, bee population, nutritional status and health of the hive. With this information, the Cooperative carries out a survey in order to determine which farmers can provide the varieties marketed by the CAP. After the honey harvest, the producer is contacted and a record of the honey containers is made in order to define their possible use for one of the brands of processed honeys. For data collection, a label number is assigned to each container and then a 250-gram sample is extracted and identified, a record of the date of harvest, label, container weight, farmer name, apiary name, color and moisture of honey is generated. Within this survey there are also the honeys resulting from the extraction of honey in Felipe Solá.

This work system makes it possible to determine the quantities of honey available for each variety, which facilitates the search and logistics process of the inputs.

4.3 Purchased inputs

Once the production quantities have been defined, the procurement of supplies is projected according to delivery times and optimal order quantities, which can be determined by logistical issues, as in the case of glass jars, where purchases are usually carried out according to the transport capacity, since in this case the incidence of the transport cost is close to 20% given the nature of the item. In other cases, such as heat seal labels, caps and collars, the quantities and financial capacity of the CAP are taken into account.

Unlike the previous supplies, honey comes from different suppliers since a product from specific zones and blooms is required. The acquisition of this input is determined according to the volume that is expected to be sold of each variety. Once the quantities are defined, producers who have the required specification are contacted in order to ensure the supply of the input and generate a profit for the producer, offering a price higher than that set by the market.

This purchase is made by the Consignment Commission who must monitor the delivery and report any complications that may occur.

4.4 Quality control during production

Quality control represents an essential tool to ensure product quality and contribute to the continuous improvement of the production process. This is why the CAP dedicates a large part of its efforts to the development of techniques and forms that ensure proper handling in the different stages of production. In the same way, it is in charge of the implementation and training of these controls. Several procedures are being implemented in the product quality control process, the records are kept on paper and a module is being developed that allows the digitization and organization of the information in the system.

4.5 Sale

The sale of honeys begins with the search for potential clients in the main cities of the country because, as it is a food product, there is a greater potential for sale in concentrated points, facilitating and reducing logistics costs. The search is centralized in food distributors and health food stores and supermarkets.

5. INITIAL SITUATION

Once the context of the development of the Cooperative's activities has been introduced, which includes the characteristics of the manufacturing and sales processes, we proceed to briefly describe the tools previously used for planning and decision-making.

To keep an order at work and to record the deliveries of the marketed products, an Excel

template was used, this allowed to record the entry and exit movements of the finished product, it also had a customer database to be able to carry out the follow-up inquires. Regarding billing, this is done through the Federal Administration of Public Revenue (AFIP) system, which requires continuous access to its portal to carry out this activity. In relation to production planning, the activities that must be carried out involve: defining production dates, assigning shifts to associates, controlling the stock of inputs and determining the raw material needs to meet the planned schedule. For this process, an Excel spreadsheet was used in which all the information on stocks and planned productions was managed.

5.1 Existing Problems

In mid-2016 CAP begins to produce and market a new brand of honeys and Jatie CAP, a pollen supplement that makes it possible to alleviate pollen deficiencies that prevent a good development of bee colonies, both productions are developed in the cities of Bahía Blanca and Rivera, respectively. This increase in the variety and volume of the products marketed produced greater requirements in terms of planning and management of purchases, production, logistics, stock and warehouse management in the scope of the different facilities and locations in the geographic area that is operated. In fact, the CAP has thirty members throughout the southwest of Buenos Aires, so it is intended that the information is available at all times.

- Alongside this background the following problems became evident:
- It was operated using a tool that only allowed one user to work at a time.
- There was a high dependence on a single person.
- Progressively, each new movement record generated larger and larger databases.
- There were difficulties in conducting sales and delivering analysis.
- The activities were carried out independently between the billing and delivery systems, which made it difficult to correctly monitor the sales orders and payment of the merchandise sold.
- There were difficulties to keep a proper control of stock of raw materials and inputs, this jeopardized the planning of production and gave the possibility of deviations in production due to the lack of some inputs or products for sale.
- The difficulties experienced to carry out a correct stock control implied a significant additional workload for the partners that was required to be able to have a real panorama of the situation.

To give a general framework on how honey is processed and thus provide a clear framework to understand the problems, Figure 2 is presented. This process begins with the reception of the honey, where the first quality control is carried out. If it fails, the entire batch is rejected. Then, with those batches that did pass the quality control, the honey is processed. First, the honey is decanted, then it is analyzed and classified according to the standards of product specifications, to go to intermediate storage. Then, the second stage begins, which is when the creaming and fractionation of the honey is carried out, and then all the established packaging operations are carried out. These products undergo a final quality control to ensure that the finished products meet all the requirements set by the specifications. Further details are presented in Figures 3 and 4.
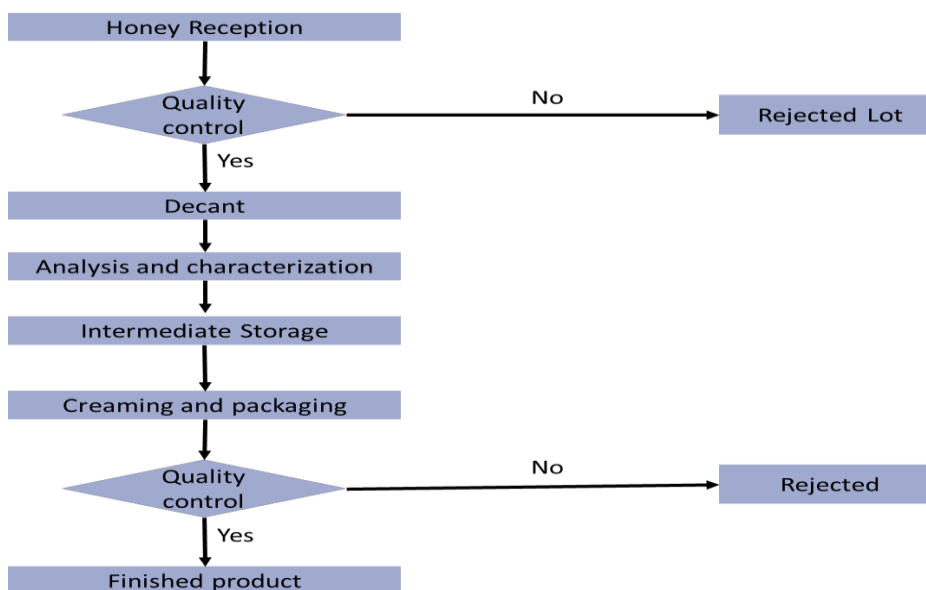

Figure 2 - Overview of the honey production process.

5.2 Production Process description

The process associated with the production of honey consists of two main stages: extraction of honey from the panels of the hives (Figure 2), and its packaging (Figure 3). The extraction process is presented in Figure 2. This process begins with the unloading of the wooden panels where the bees stock the honey, then immediately, the first quality control is carried out on the humidity level of the honey contained in those panels. In case the humidity exceeds the threshold of 18%, the entire batch is discarded. Otherwise, the process continues. The next operation consists of opening the operculums where the bees stock the honey and close them with wax, designated as uncap in Figure 2. Beeswax is obtained as a by-product from this process. Once the operculums are open, the honey is decanted where the honey is extracted from the wooden panels and stored in containers of 200 liters each. Then, these containers that make up a production batch are sampled and analyzed in terms of quality and classification of honey. CAP produces more than 6 different types of honey, depending on the bee colony, the surrounding flora and other factors of the biological process. Once the batch is typified, the production is stored.
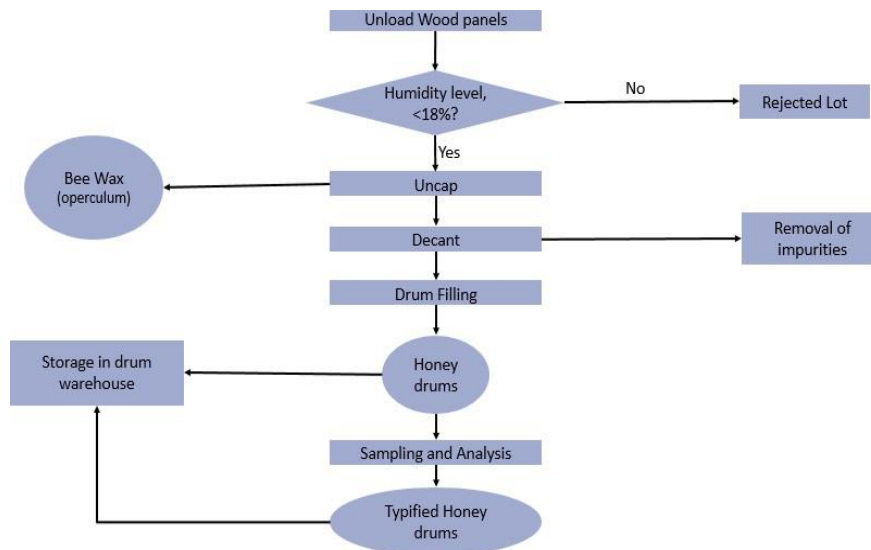

Figure 3 - Honey extraction process.

In the next stage of the process, which can occur with a significant time interval between both stages, the honey is fractionated and packaged, as illustrated in Figure 3. For this, the whipping (creaming) operation must first be carried out, where the honey is processed mechanically in order to aerate and, above all, remove impurities that have been suspended within the honey. When the honey is free of impurities, it is fractionated and packaged, in the different presentation varieties of the product. Then the filled honey containers are labeled, and the final quality control is carried out. If this control does not meet the quality standards, the lot must be rejected. This requirement in quality control is central because the final destination of the honey is the foreign market, where quality controls are very demanding.
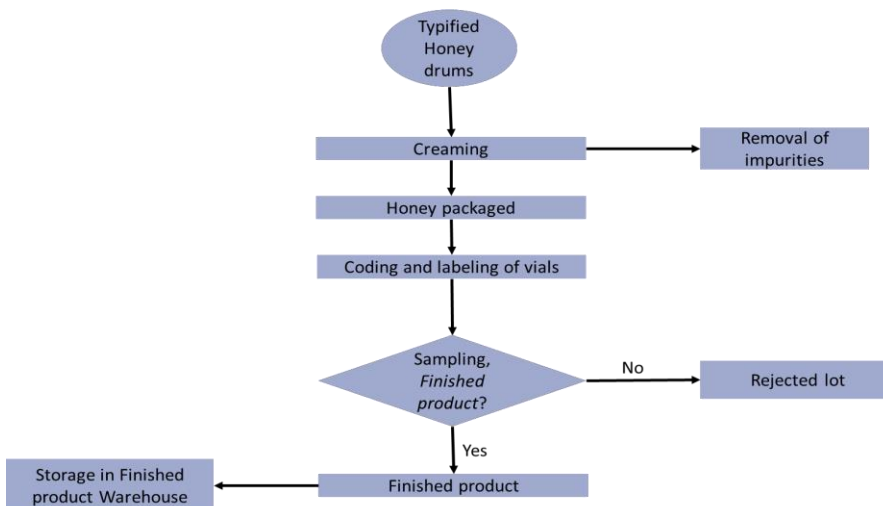

Figure 4 - Honey fractioning and labeling.

5.3 Search for a solution through the selection of an ERP system

The rapid growth due to the development and manufacture of new products made the use of Excel spreadsheets obsolete for the management and planning of the company's operations. Although there is some degree of digitization of the information, since they use spreadsheets, much of the information about stocks and billing is kept in physical format. This physical support limits considerably the access to information by
each partner/owner (being a cooperative, each member is the owner of the organization), since they must travel to the place where those files are housed. In turn, given the nature of a cooperative, decision-making processes are expected to be decentralized, however, being such a large area in which the partners/owners are scattered (within a radius of more than 300 km), and the fact that there is information in physical support ends up generating an imbalance in the decision process, centralizing it in those partners/owners who are physically close to the production plant. In addition, shared spreadsheets are not always an adequate means to work in a coordinated and decentralized manner when the number of participants is large, since it leads to overwriting of information or directly deleting important data. To overcome this, the partners/owners decided to restrict access to spreadsheets to only those partners/owners who used to do the purchasing and management. This situation further limits information access to the rest of partners/owners.

All this motivated the search for enterprise information systems that respected the decentralized nature of the cooperative. Naturally, ones of the means used to reduce the impact of the physical distance between partners/owners when making decisions is digitization. The digitization of information allows the information to be replicated and shared as many times as necessary, maintaining its accuracy and fidelity, and in real time. Therefore, a software-based approach was proposed as a solution, which would allow each partner/owner to share information and status on equal terms.

This search led to the acquisition of a specific software system for business management. Currently there is a wide variety of ERP systems on the market with different functionalities for managing resources, which is why an analysis of the available options was carried out in order to acquire a product according to the needs of the Cooperative (Schlichter et al. 2021). During the search for a suitable software tool, the different activities carried out by the CAP and the importance of each of these modules for the operation of the organization were taken into account, the points to be considered were the following:

Stock control module: It is important to have a correct stock control that allows knowing in real time what supplies and products the organization has, and visualizing the evolution of inventory levels in the different warehouses.

Purchase and sales module: In order to correctly and efficiently carry out the organization's accounting, a module is necessary that allows the generation of a database of customers and suppliers and the corresponding monitoring.

Electronic invoicing: Electronic invoicing is a tool that streamlines the sales process by eliminating paper and helps to eradicate calculation errors that may arise.

Manufacturing module: This module allows to perform calculations and determine the requirements of materials and subassemblies for the manufacture of a specific product.

Access from the web: Because most of the partners are located in different parts of the country, access from the internet makes the work easier and allows to see all the information in real time.

Customizable: CAP has professionals and technicians from different branches and is continually developing new techniques and products, which is why it is necessary to have a tool that allows the creation of forms and databases for research.

Price: Price is another characteristic to take into account since there are highly developed systems for the industry, but their costs can be very high.

Table 1 -Comparative table of the analyzed ERP systems. Ref: Y: yes, N:no.

Feature	Considered Systems			
	Jaque	Holistor	ERP NEXT	SAP
Warehouse Module	Y	Y	Y	Y
Buying and Selling module	Y	Y	Y	Y
Electronic billing	Y	Y	Y	Y
Manufacturing Module	N	N	Y	Y
Web Access	N	N	Y	Y
Customizable	N	N	Y	N

Price	Low	Low	Medium	Very high

After carrying out an analysis of the different systems presented in Table 1, it was decided to acquire the ERP NEXT software, which is a system that works completely based on the cloud and allows access from any computer with internet access, it also allows having a personal user for each partner of the Cooperative. Among the advantages that were observed with respect to other software, the manufacturing sub-module stands out, which is usually in very high value systems, another point to take into account is the possibility of developing new modules within the same system. A very useful tool since it allows the digitization of all the information developed by the Cooperative, it has a simple interface to work through a customizable desktop according to the user's work.

6. IMPLEMENTATION OF THE ERP NEXT SYSTEM

The ERP NEXT system is a business management software that allows integrating the different functional areas of a company, such as sales, purchasing, manufacturing, accounting and finance, as well as allowing the development of new interfaces and functionalities in response to the needs of the company.

Each module that is enabled in the system allows to operate with filters that help in the search for information, being able to carry out searches based on a certain chosen field, in the same way it allows to generate customizable reports to be able to sort the information, an important tool for taking of decisions. Once the functionalities of each of the modules were known, the system was implemented. In the first instance, the loading of the databases on which the system is developed and that are necessary for a correct interaction between the other modules was completed.

Next, a brief description of the modules used by the CAP that are part of the implementation of the management system is given and, as a fundamental aspect of this work, they facilitate the optimization of production planning and stock control.

- Desktop: The initial screen when entering the system shows a desktop from which you can access the different work areas. This is customizable according to the user. In Figure 5 it can be seen a view of the application desktop.
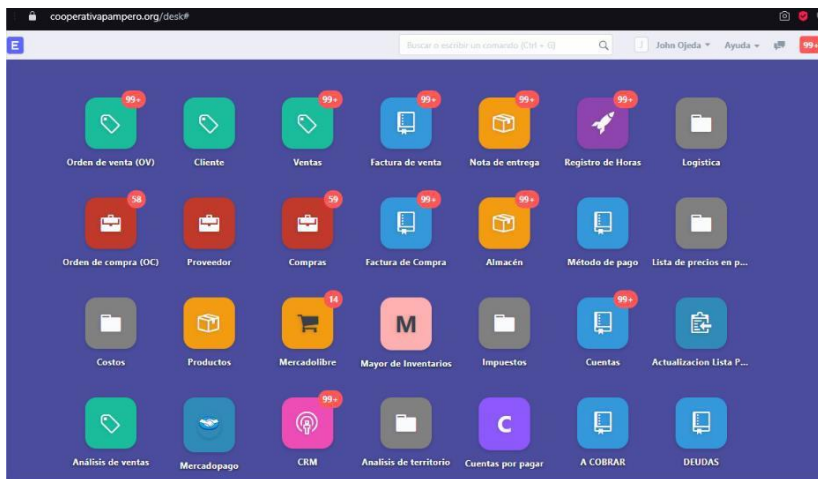

Figure 5 - Desktop illustration from the ERP NEXT implementation.

- Sales module: It is made up of the customer, sales order and billing sections. From this module, the CAP sales follow-up is conducted, being able to carry out billing reports, record payments, orders delivered or pending delivery. Figure 6 shows the initial screen of this module.
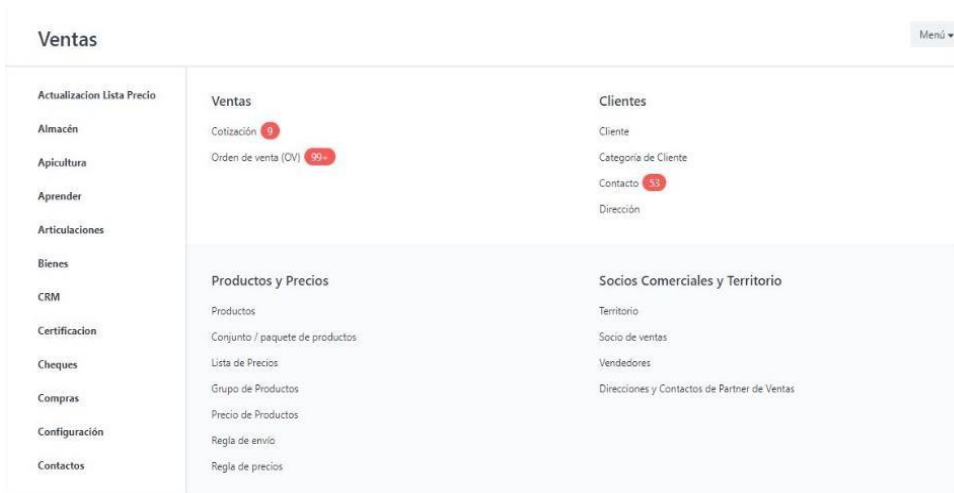
Figure 6 - ERP NEXT's sales module.

- Purchasing module: It is composed of suppliers, purchase orders and invoicing. In the same way as sales, this module allows you to track purchases, being able to identify purchases pending delivery, payment or billing, this can be seen in Figure 7.
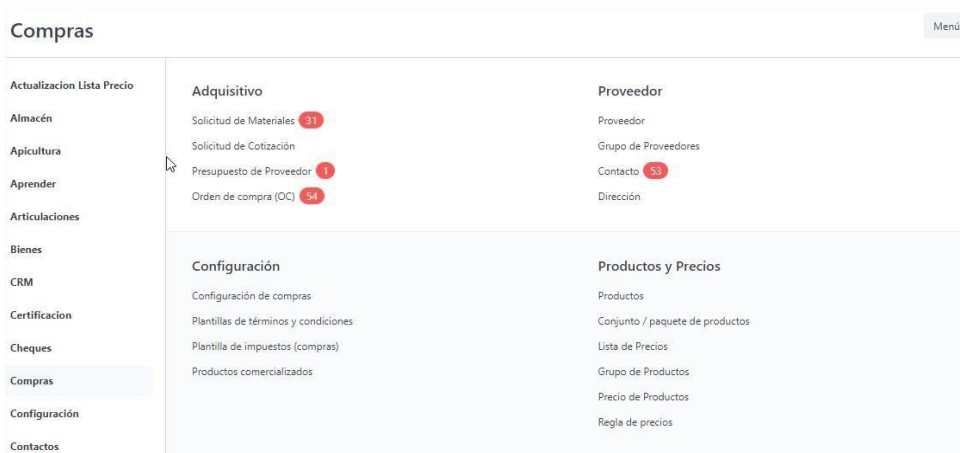

Figure 7 - Purchasing module capture from ERP NEXT implementation.

- Warehouse module: Composed of the product section, warehouse, delivery notes and receipt of purchases. It allows the creation of new products, warehouses and recording the inputs and outputs of products, as shown in Figure 8.
- Manufacturing module: Composed of work orders, bill of materials (BOM) and inventory entries. It allows the creation of new production orders from a BOM and the recording of the transformation of inputs into finished products, this is observed in Figure 9.
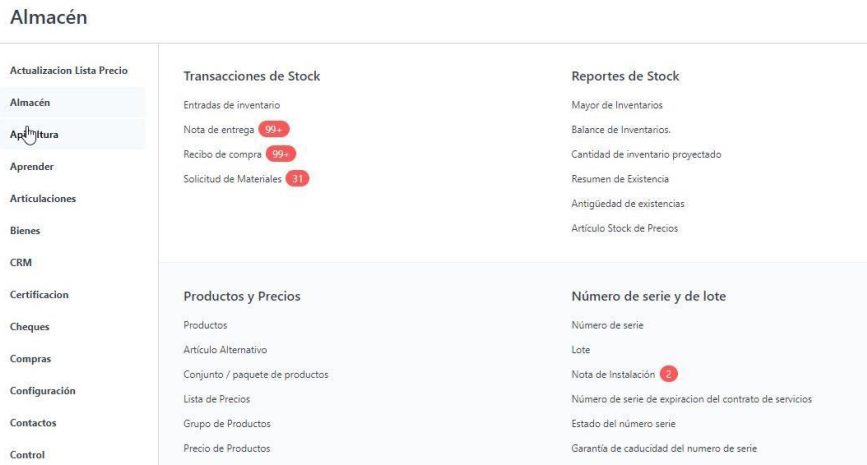
Figure 8 - Warehouse module from ERP NEXT implementation.

Figure 9 - Manufacturing module from ERP NEXT implementation.

6.1 Multi-user implementation

The chart of accounts is a list that, through accounting records, seeks to group the operations carried out by an organization into different headings. This is a systematic ordering of all the accounts that are part of the accounting system.

To facilitate the recognition of the accounts, a coding procedure is carried out to allow the classification at different levels according to the characteristics of the operations. The documents generated in the system that involve movements in the chart of accounts present three basic states:

- Draft: A new document is generated and the uploaded information is saved but said movement has not been confirmed, this may be due to the lack of some data.
- Validated: the generated document is saved and its movement is confirmed, unlike the draft status, from this document other operations can be carried out, as in the case of an invoice, in which a payment
- can be generated. Once validated, the respective accounting entry is generated. The validated status is also used in manufacturing operations where work orders or bills of materials are entered.
- Cancelled: it occurs in the case in which the validated document contained an error, a document can only be cancelled if there is no subsequent action associated with it and gives the possibility of correcting it.

6.2 New tailored developments in the implementation

The ERP NEXT system, through the Configuration module, gives the possibility of generating new modules for the development of the company's activities; these modules can

be requested from the technical service of the system or they can be developed by the company itself. Depending on the particular needs of the Cooperative, the development of a tool to control honey extraction and another for quality control and production records was required.

7. RESULTS AND DISCUSSION

The implementation of the ERP NEXT system allowed the use of a single platform for all internal areas of the CAP, providing a tool for development, support and storage of all the information generated, ensuring transparency and visibility for all transactions of all members of the company.

In a period of two months, it was possible to carry out an initial load of customers, suppliers and products, in this way the system worked in principle as a basic stock control system. After this step, progress was made on the manufacturing module, to then advance on the development of new modules to facilitate the work of the members of the CAP.

The integration of the different functions related to inputs and outputs of items presents a great advance for the CAP, since it allows operating in manufacturing, buying and selling in the same platform with information in real time. This facilitates the interaction between the different areas. It operates following the same concept according to the tools provided by the system, reducing errors due to differences in the approaches of the parties.

The incorporation of the system also helped to achieve a better organization within the warehouses of the CAP by systematizing the output of products with emphasis on batches, forcing compliance with the dictates of the system according to the production date. The frequency of stock control was reduced to once a month.

The warehouse module in the system provides the necessary tools to carry out a correct movement control of the items and supplies a basis for the organization and order within the warehouses and CAP headquarters. In this way, stock control is facilitated and responsibility is requested in the loading of movements by those in charge of each sector in order to reduce the differences that can be generated, in this sense the hours used for these controls were reduced to 70 %, reducing labor costs by 2%.

The manufacturing module is a necessary implementation for any company dedicated to production, allowing the transformation of inputs into finished products, the manufacturing module of the ERP NEXT system fulfills this function, but leaves no room to identify possible waste or rejections that may occur in production, being necessary a stock adjustment, it also does not have a planning system for material requirements working correctly. These enhancements are expected to be made in the future in order to take full advantage of the tools provided by the system. During the review of some accounting movements, errors were found in the configuration of warehouses, accounts and their use, which makes it difficult to reconcile the accounting records.

There are also differences between the values of the products and those used by the system when calculating expenses. It is required to examine this topic and solve this problem. At the same time, it is proposed to develop a form to determine the cost of production of finished products, taking into account the inputs, services and labor invested for their manufacture.

As this is a new system in the country, the lack of information on local implementations posed a difficulty, however, it allowed it to be adapted to the needs that the organization required and new tools to be developed.

However, at this point, our study constitutes a contribution in this topic. Since it represents a successful implementation case, where the ERP system could be tailored and adjusted to the requirements of the agricultural system. This issue is not trivial, because in the recent studies of Kulikov et al. (2020) and Shukor et al. (2020), it was highlighted as one of the main barriers in the adoption of information technologies by farm systems. Both articles remark that when farm production systems do not fit "naturally" on the architecture required by ERP systems, then the adoption of such technologies become complex and cumbersome. Nonetheless , those studies also indicate that the cases where ERP system could be adopted, advantages and results were very positive. Then, our study provides a new study on the implementation of a very flexible ERP system, which could be tailored according to the farm system's needs.

Another comment that can be made is that ERP systems leverage the whole management of the system by making all the operations and processes well defined and clear, i.e., by means of routinization and standardization. This issue for farm systems was previously studied by Junior et al. (2019). In their work Junior et al., concluded that ERP systems and the deployment of routines for operations and processes gives a common structure to the organization avoiding the waste of time and resources that occurs when the farmer tries to solve each

situation/problem in his own way. For our case, this was demonstrated since the system considered here is a cooperative, and then, the different manners of solving situations/problems used to be really heterogeneous. This variability led to large inefficiencies, mostly in warehouse management. After the implementation of the ERP system and the definition of protocols for the warehouse management, the performance of this module of the system overcame completely the previous warehouse management operation. Even more, the new implementation has paved the way to obtain predictability on stock control, which also helps to improve supplier relationship management.

7.1. Theoretical and Managerial implications

This case study proves that it is possible to address an agricultural production management problem through digital production management technologies. A central aspect of this work was the need to use an approach for a decentralized decision-making process like, by definition, a cooperative industrial organization is. This type of situation implies a very strong conditioning when analyzing potential system solutions, since the survival of the organization is based on the equality that exists between the owners/producers. This equality was threatened, leading to unresolved conflicts and efficiency losses typical of working in organizational silos.

As a theoretical-practical result, it can be highlighted that digital technologies supported by the cloud are a more than effective means to achieve a fully equitable distribution of power and access to information among the interested parties. These technologies allow an identical replica for each user of all the information and the real state of the situation. In addition, through ERP platforms such as the ones proposed here, they allow the different users to have equal participation in the decision processes. Therefore, this case study allows us to show that this type of technology is not just a management tool for cooperative-type organizations, but also enhances its actions by giving a dynamism and management capacity that, aligning itself with the basic principles of cooperatives, leverages the capabilities they would not have without these technologies.

Additionally, it is worth noting that these types of tools today have a much lower investment cost than management systems of previous decades. This type of systems that can run on mobile phone applications and personal computers, having the main host support in the cloud, allow organizations to scale their use and investment according to their needs. In other words, it is not necessary to buy an oversized system, instead they can pay a fee based on, for example, the number of users. On the other hand, this type of technology, by digitizing management processes, automatically collects data, so the generation of reports, as well as statistics associated with the processes, is greatly facilitated. This entails improving the inputs for further decision making.

8. CONCLUSIONS

Carrying out this work involved framing a broad view of the activities carried out in CAP in order to organize them within a management system. The process required speed in its execution since the change was necessary to continue with the normal operations of CAP. The integration of the various functions of CAP through the ERP NEXT system provides a useful tool and allows coordination between the different areas. During the development of this work, a better communication was observed between two of the areas, in charge of purchasing, manufacturing and selling.

The production record is in the development process, so it is necessary to make improvements that facilitate its use and extension to other products. From what has been observed after a few months of use, it is proposed to unify the batch registration module developed by CAP together with the module presented by the system, in this way the amount of duplicate information is reduced and the data can be obtained from a single form. It is also proposed to add the protocols for quality tests that indicate whether the finished product is in a condition to be marketed. As it seeks to implement new records related to cleaning, maintenance and audits, it is proposed to develop a new module for the creation of these protocols and for the records to which they will be associated. The possibility of generating new tools within the system represents an important characteristic that allows to support the development of the activities and the studies that are carried out. The use of the system is increasingly intensive and the Cooperative has members trained to develop new modules, so it is a fact to highlight that more functionalities and tools are added to facilitate daily and planning activities. This versatility of the system is a very important quality and it is adapted to the way of working of the company.

Regarding general conclusions, it can be said that cloud-based ERP systems are a key technology for leveraging rural cooperatives, it allows to hire the amount of service that they require and to scale the usage by demand. It also facilitates the access to the information and the system with very low investment in hardware.

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