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DISEÑO DE LA CADENA DE VALOR EN LA PRODUCCIÓN DE RESINA DE PINO

DESIGN OF THE VALUE CHAIN IN THE PRODUCTION OF PINE RESIN

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RESUMEN

El modelo económico cubano llevada consigo la reestructuración de las relaciones empresariales para su inserción en el mercado. Se ejecuta un estudio de abordajes teóricos afines con la aproximación de los ciclos productivos, cadenas productivas y cadena de valor industrial. Teniendo como objetivo diseñar un procedimiento para esbozar la cadena de valor de la resina de pino en la empresa Agroforestal de Pinar del Río, mediante una metodología cualitativa y cuantitativa donde se realiza un análisis de los métodos a utilizar para recopilar la in-

PALABRAS CLAVE

Cadena De Valor, Competitividad, Encadenamientos, Resina De Pino

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formación y procesar los resultados. Como resultados se obtienen el diseño de la cadena de valor de la resina y actividades generadoras de costo y valor, para en un futuro calcular las utilidades. Los hallazgos de la investigación permiten una mejor comprensión del fenómeno abordado, para posicionar el producto ante la competencia, direccionar estratégicamente los recursos materiales y financieros.

ABSTRACT

The Cuban economic model brought with it the restructuring of business relations for its insertion into the market. A study of theoretical approaches related to production cycles, production chains, and the industrial value chain is carried out. The objective is to design a procedure to outline the value chain of pine resin in the Agroforestal company of Pinar del Río, using a qualitative and quantitative methodology that analyzes the methods for collecting information and processing results. The outcomes include the design of the resin value chain and activities that generate cost and value, enabling future profit calculations. The research findings provide a better understanding of the phenomenon, allowing the product to be positioned competitively and material and financial resources to be strategically directed.

KEYWORDS

Value Chain, Competitiveness, Linkages, Pine Resin

INTRODUCTION

The extraction of pine resin has an extensive market due to its countless uses, being produced and traded internationally. As noted by Faldt (2000), in Asia, resin tapping is practiced by small family groups or individuals, who employ a system for its extraction based on cutting a V-shaped groove without chemical stimulants, descending to reach the secondary xylem.

For Belgacem and Gandini (2008), once the turpentine was separated, it was used as a sealant and waterproofing agent, the primary application of this resource for shipbuilding and maintenance between the 19th and 20th centuries in Spain.

In Mexico, the resin industry began to develop in the early 20th century, driven by Spanish and North American entrepreneurs. The global resin industry was going through a rough patch, and Mexico was a convenient location for new rosin production, becoming a tradable raw material. The expansion of resin production was carried out by the Mexican Forest Service. The company's main objective was the survival of woodlands through the principles of a new science in Mexico: forestry. The first organizer of this initiative was Miguel Ángel de Quevedo (1862–1946) (Urquiza, 2018).

In Cuba, research in this sector began in 1980, leading to the implementation of techniques for extracting resin from standing pine trees. By 1989, specific progress had been made in the sector. In 1990, production was affected by the "Special Period." A slight recovery was attempted in 1994. The imbalance was caused by several factors: lack of raw materials, insufficient incentives to retain labor, and disorganization (Amoedo, 2008).

In the current context of the international economy, the value chain is timely as a tool for designing and implementing industrial strategies in a saturated market with firm changes and increasingly rigorous consumer demands. The chain focuses on creating value for customers by strengthening internal activities or capabilities, which allows for the formation of a competitive advantage (Rojas *et al.*, 2021).

The value chain fosters internal cooperation and coordination of activities derived from its functions, enhancing production and technological development capabilities.

The motivation for this research stems from the insufficient use of the value chain as an analytical tool, which prevents the Agroforestal company of Pinar del Río from identifying the activities and processes that transform and add value for future profit calculations and proper accounting management, aiming to achieve competitive results.

Given the above, the problem is framed by the question: How can the value chain in pine resin production be designed for the Agroforestal company to facilitate decision-making and achieve competitiveness? The general objective of the research is to present the design of the value chain in pine resin production for the Agroforestal company of Pinar del Río.

THEORETICAL AND CONCEPTUAL BACKGROUND

Conceptualization of productive linkages

AAlbert Otto Hirschman suggests that "there are two types of linkages: backward and forward. [...] Backward linkages occur when any non-primary economic activity induces attempts to supply the necessary inputs for that activity through domestic production" (Hirschman, 1964:106).

A linkage is understood as a long-term relationship established between business units to obtain joint benefits (Peña, 2005).

The linkage approach is one of the most methodologically prioritized requirements for analyzing the variables that form a system of relationships, both internal and external (Anaya, 2015).

Nova *et al.* (2020) outline the concept of linkage as a long-term relationship created between business units to achieve mutual gains and maintain the resulting econo-

mic and social benefits.

Productive linkages strengthen the economy by accelerating collaboration among producers, intermediaries, transporters, employees, and entrepreneurs, creating articulation at each stage (Mera *et al.*, 2021).

Pérez and Vega (2021) argue that linkages should focus on the economic, social, and environmental benefits derived rather than on the linkages themselves.

The value chain as an analysis tool

Porter's model (1985) posits that competitive advantage is driven by industry organization and is influenced by its structure. From this perspective, the environment largely determines competitive advantage and performance, as all activities must control costs that influence the creation of an advantage.

Porter (1998) mentions that each process within the organization must have a long-term competitive advantage, either through differentiation or cost leadership. Therefore, it is crucial to analyze each link individually so managers can study them separately to make informed decisions. Thus, an effective management team is essential to add value through a flow methodology or a goal-oriented management approach.

The characteristics of the value chain are categorized by the number of involved representatives, the actors governing it, its territorial significance, and the product's investment value, as noted by Oddone and Padilla (2018).

Springer (2018) states that the value chain is defined as a socio-economic system containing all entities that serve a particular market. These entities establish the value chain through frequent trade, acquiring and transferring effects and goods, exchanging information, and achieving simultaneous benefits.

According to Guzmán and Chire (2019), the value chain identifies competitors' sources through a process to generate embedded value, based on cost- and va-

lue-creating activities that allow any company to act on elements requiring reinforcement.

The value chain is a theoretical model describing the dynamics of an entity to create value for the end customer and the company itself (Riquelme, 2020).

It is a tool for intrinsic analysis to learn about the main actions carried out by a company and identify which links generate value or competitive advantage in the final product. In 1985, Professor Porter at Harvard University theoretically designed the concepts of the value chain to achieve favorable market evaluation, distinguishing two types of activities: primary and support. Each generates a cost and value on the final product, called margin (Fernández, 2021).

Vecino Guerra *et al.* (2022) confirm that the amount of value created in the chain links allows the study of value creation traceability, identifying value sources and addressing continuous improvement conditions while comparing periodically with value generated in other value chains of the same product.

The productive chain as the basis of the value chain

Studies of local productive chains, productive succession, the level of perfection, and the formalization of operations have gained significant academic attention in recent years. The fundamental and habitual definition of the value chain refers to a theoretical model detailing the activities a structure must develop within its productive process (Peñaherrera, 2018).

The productive chain spans from the origin and cause of raw material production to final use. Some actors are clearly involved in manufacturing, innovation, and product commercialization, while others provide goods and services required in this process (Nova *et al.*, 2018).

Productive chains have not only a productive but also a social basis, recognizing the reasonable development of groups. They require collective contributions from their members to develop general interests that motivate the strengthening of all

chain links (Vargas *et al.*, 2019).

Industrial value chain

Porter established a model as a system that generates value for a company, which he called the value chain (Figure 1). The activities of suppliers, distribution channel members, and customers are included. He mentions that the value chain focuses on the goal and vision designed by companies, as a process involving multiple small processes from different areas forming a global system, where organizational resources intervene. Costs are determined based on all activities performed along the value chain, consequently linking to organizational profit (Porter, 1985). Porter (1986) states that value is a notion determined based on the benefits received by the customer, minus the perceived costs when acquiring or using certain products or services. In academia, the value chain becomes a tool for internal analysis of a company's essential activities, helping to identify which activities enable value creation and, therefore, potential competitive advantages in a product (Vázquez *et al.*, 2021).

The value chain describes the range of activities required to bring a product or service from conception to delivery to final consumers and its disposal after use (Kaplinsky & Morris, 2000 and Kaplinsky & Morris, 2016). Similarly, it details how producers, processors, buyers, sellers, and consumers, separated in time and space, gradually add value to products as they move from one link to another (Hartwich & Kormawa, 2009).

Porter (2015) asserts: "The organization of manufacturing shapes the value chain and reflects competencies" (p. 144).

Value-added chains within an organization's boundaries have been widely discussed in the discipline of industrial economics at the micro level (Armaghan & Emrah, 2022). Porter (1980 and 1985) made a significant contribution by developing a value chain model for companies and discussing their competitive advantages. The industry value chain perspective analyzes the supply flow along the product value chain and sheds light on a company's characteristics at different stages. It exp-

lains company behavior in terms of strategic choices, particularly regarding process-product and how they respond to market forces, customers, and other parts of the value chain (Armaghan & Emrah, 2022).

The links of the value chain are divided into primary and support activities. According to Porter (1985), the primary activities are:

Inbound Logistics: Involves relationships with suppliers and includes all activities necessary to receive, store, and distribute inputs.

- Operations: All activities required to transform inputs into outputs.
- Outbound Logistics: Includes all activities necessary to collect, store, and distribute the output.
- Marketing and Sales: Activities inform buyers about products and services, induce them to purchase, and facilitate their purchase.
- Service: Includes all activities necessary to maintain the product functioning effectively for sale and delivery.

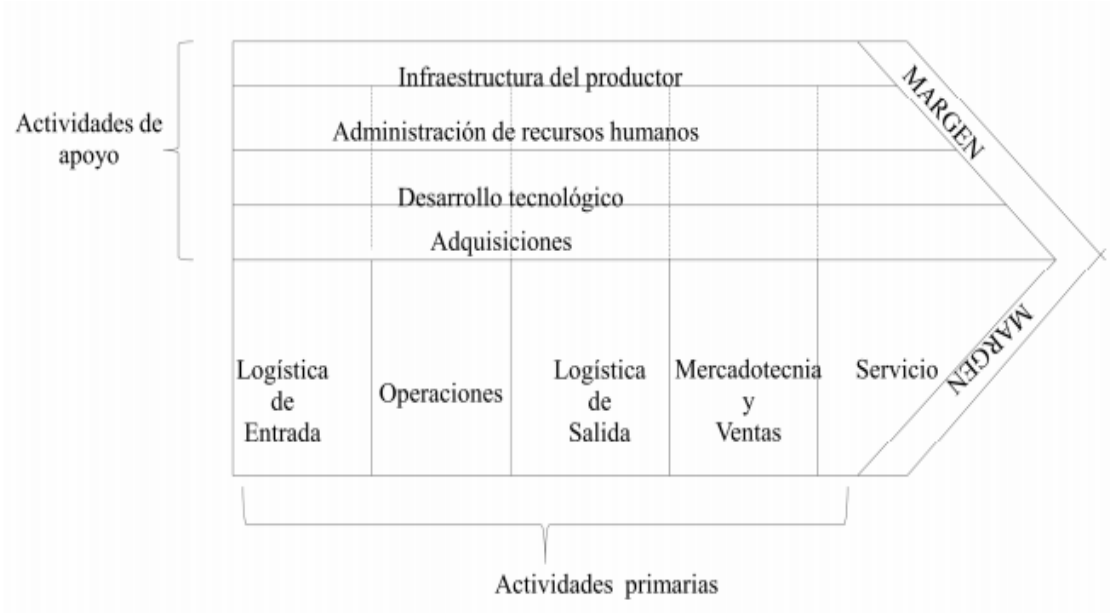
Similarly, Porter (1985) indicates that support activities are:

- Procurement: The acquisition of inputs or resources for the company.
- Human Resource Management: Consists of all activities involved in recruitment, hiring, training, development, and compensation.
- Technological Development: Refers to equipment, hardware, software, procedures, and technical knowledge influencing the company's transformation of inputs into outputs.
- Producer infrastructure: Addresses the company's needs and connects its va-

rious parts, consisting of functions or departments such as accounting, legal, finance, planning, public affairs, government relations, quality assurance, and general management.

Figure 1

The generic value chain



Source: (Porter, 2006).

Kaleka and Morgan (2017) affirm that the concept of the industrial value chain has gained prominence in issues of productive capability. Thus, one of the main challenges organizations face today is how to maintain superior competencies and, additionally, the ability to be creative and transformative.

Simatupang, Piboonrungroj, and Williams (2017) present a conceptual model consisting of four steps: value discovery, value design, value delivery, and value capture.

Rojas *et al.* (2023a) state that the industrial value chain enables the management

of activities and processes linked to business activity for the creation of a competitive product and/or service in the market.

METHODOLOGY

The research had a qualitative and quantitative character, with the Agroforestal company of Pinar del Río as the study object. The methods employed were as follows:

According to Hernández *et al.* (n.d.), the following theoretical methods were used to develop the theoretical framework:

- Historical (trend-based) and logical: To analyze the improvement, refinement, and attributes of the value chain and the study regarding the variety of judgments related to other forms, knowledge, and methods for its implementation.
- Analysis and synthesis: Used in the critical evaluation of the theoretical and contextual framework related to the value chain, based on profit calculation to manage the company's model and expansion regarding other reasoning for its development.
- Systemic-Structural: To base the proposal of the procedure for outlining the value chain in the decision-making process by the company, enabling effective execution of its tasks and the validity of its results.
- Modeling: For the design of the procedure related to the value chain to achieve the objectives.

For data collection, the following empirical methods were used:
Document Analysis: Used to adjust and catalog the selected bibliographic material pertaining to the value chain, to study these ideas in Cuba and internationally, for diagnosing the research object.

Surveys: To identify whether the components of the procedure related to the value chain design are considered in the process of acquiring efficiency by the entity's managers.

A population of 115 people was established. To achieve this intention, the arguments presented by Calero (1976) were used. Unrestricted random sampling (URS) was employed, with a 95% confidence level, a proportion of 0.50 (allowing the largest sample size), and a sampling error of 0.05. The result indicated that 65 production workers and 30 administrative workers should be surveyed, totaling 95 workers as the sample. In Cuba, there are ten Agroforestal companies, one of which is in Pinar del Río, an organization dedicated to economic activities to meet the market demand for forest products while ensuring the continuity of the commercial structure and its investments. The study lasted two years, involving fieldwork and necessary information gathering.

Based on Rojas *et al.* (2022a) and Rojas *et al.* (2022d), the following steps were followed in preparing the examination results:

1. Topic search.
2. Literature review.
3. Problem outline.
4. Objective specification.
5. Justification and establishment.
6. Theoretical framework outline.
7. Methodology analysis.
8. Research methods and materials.
9. Data collection.
10. Results study.
11. Conclusions.

RESULTS

Through the previously analyzed works, as shown in Figure 2, the proposed procedure for designing the value chain in pine resin production is presented.

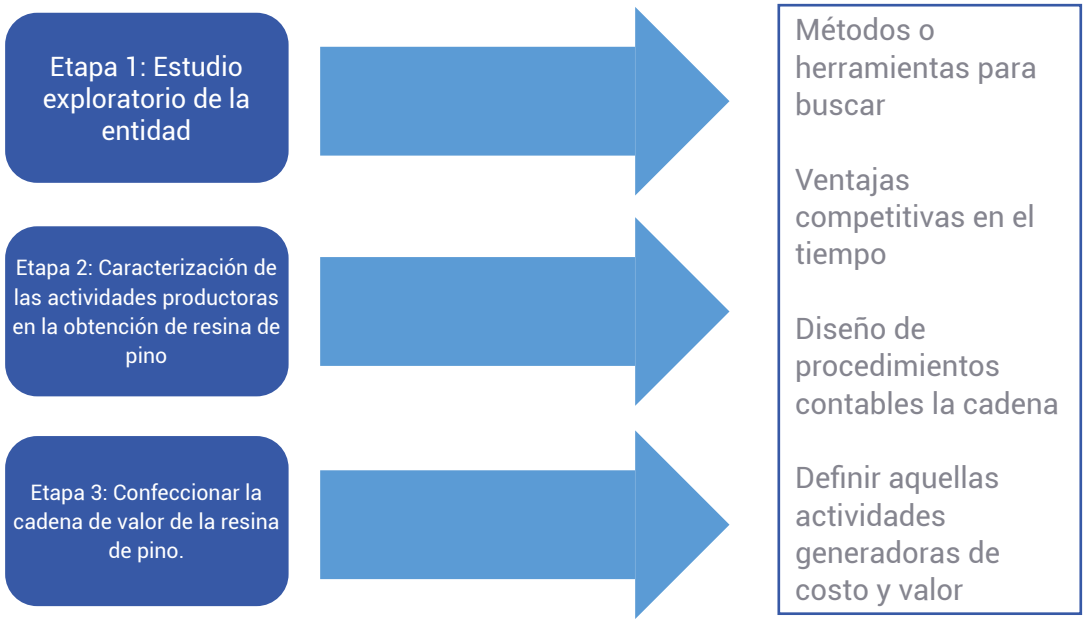
The proposal is structured in three stages:

- Stage 1: Exploratory study of the entity.
- Stage 2: Characterization of productive activities in pine resin extraction.
- Stage 3: Preparation of the pine resin value chain.

Each stage is specified by: methods or tools to seek competitive advantages over time, design of accounting procedures for the chain, defining cost- and value-generating activities, and calculating profits.

Figure 2

Procedure for designing the value chain in pine resin production.



Source: Own elaboration, based on Rojas *et al.* (2021).

Stage 1: exploratory study of the entity

This stage involves the necessary selection of all company inquiries to understand its operations.

Company characterization

The Agroforestal company of Pinar del Río was created on December 15, 1976, through Resolution 9/76, establishing that the Ministry of Economy and Planning, with its legal address at Km. 3 ½ Luis Lazo Road, Pinar del Río. The defined mission is: The production of seeds of all forest and fruit species, the reforestation of deforested areas and natural regeneration of all forest formations and categories, as well as their silvicultural management, protection against pests, diseases, and fires.

Market analysis of the Agroforestal Company, Pinar Del Río, in pine resin production

Cuban non-timber forest products show a trend toward increased production of their derivatives (pine resin, rosin, turpentine, and gum spirits) with high catalogs and quality measures, obtained from their ecologically sustainable derivatives and components. The focus is on progress and design in the market of the Cuban National Forest Industry and its byproducts. The importance of developing new synthesized procedures, catalytic and ordered methods, as well as the evaluation of biological and pharmacological properties of new products created from resin and rosin of Cuban pine species is emphasized.

The Agroforestal company of Pinar del Río has national market clients, including:

⇒ The National Match Company: purchases the byproduct turpentine, with an annual quantity of 20 tons for match production.

⇒ LABIOFAM Company: purchases rosin and turpentine, with annual quantities of 5 and 6 tons, respectively, for pharmaceutical product production.

⇒ Petroleum Laboratory Company: purchases rosin in quantities of 10 tons for chemical fuel treatment and turpentine in smaller quantities of 5 tons, used as a fuel solvent.

The international market defined by the Agroforestal company includes:

⇒ Mexican company DEVOX: purchases turpentine and rosin in quantities exceeding 20 tons for paint production and use as solvents in the industry.

⇒ UNILEVER S.A.: purchases turpentine and rosin in quantities exceeding 10 tons for paint, varnish, mixture, and waterproofing production.

General characterization of suppliers and regulators of the Agroforestal Company, Pinar del Río

Suppliers of raw materials for pine resin production:

⇒ CONSTRUIMPORT: an importing company that sells common resources to the company (files, machetes, clothing, and chainsaws).

⇒ MAQUIMPORT: a Cuban importing company allowing the import of specialized resources (blades, pickaxes).

⇒ CUPET: a Cuban fuel marketing company supplying Agroforestal with petroleum, gasoline, lubricants, and liquefied petroleum gas.

⇒ DIVEP: A Cuban marketing company dedicated to selling hammers, plates, and gloves to Agroforestal.

⇒ Union of military companies: dedicated to selling plastic resin cubes to the entity.

Regulators of the Agroforestal company:

⇒ State Forest Service: a regulatory entity of the Cuban state responsible for controlling all forestry activities of the company, ensuring no indiscriminate or illegal logging occurs. They also monitor silvicultural management of plantations, verifying this activity is performed in all forests.

⇒ Forest Rangers Corps: Authorized to ensure environmental protection, applying corresponding measures in compliance with forestry law. In case of non-compliance by the entity, they are authorized by Forestry Law No. 85 of 1998 to impose personal fines up to 8,000 Cuban pesos (CUP).

⇒ Ministry of Science, Technology, and Environment: Conducts state environmental inspections of the company, characterized as a substantially protective, control, inspection, and surveillance activity of compliance with current legal skills and norms in the country regarding environmental protection and sustainable use of natural resources.

⇒ Ministry of Agriculture: Controls and directs state policy through soil use and conservation; ownership and enjoyment of agricultural and forest land; and plant health.

⇒ Ministry of Economy and Planning: Establishes cooperation and coordination relationships at the territorial level to achieve the most rational use of available resources, greater productive economic efficiency, and corresponding assurance of compliance.

⇒ Ministry of Finance and Prices: Establishes and ensures the application of Financial, Tax, and Price Policies of the state, monitoring international market price behavior for exports and imports, proposing corresponding measures.

⇒ Flora and Fauna Company: Regulates reforestation and deforestation activities carried out by Agroforestal, ensuring the care of animal and plant life inhabiting the forests.

Stage 2: Characterization of productive activities in pine resin extraction

An outline of the main activities for pine resin production is made, through specialist knowledge.

Stage 3: Design the pine resin value chain

The study of how to design the proposed value chain is carried out, along with the selection of all study material.

Using methods for data collection (document analysis and observation), a diagnosis was made based on activities and processes for pine resin extraction, referencing studies by authors such as López (2016); Rojas (2017); Domínguez *et al.* (2017); Rojas *et al.* (2021); Rojas *et al.* (2022b); Rojas *et al.* (2022c); and Rojas *et al.* (2023b), to create a series of steps for designing the value chain of the product under study.

Main problems diagnosed with the pine resin value chain as support in accounting management for profit calculation in the Agroforestal Company of Pinar del Río:

1. Monthly analysis of raw material consumption and materials destined for the production area is not conducted.
2. Activities in the value chain are not classified as cost-generating or value-generating.
3. Productive processes are incompletely defined, preventing their identification in the chain links.
4. The company has defined its suppliers, clients, and regulators but does not view them as chain actors for each activity.
5. There is no certified economic-financial projection to achieve expected efficiency.
6. The company lacks automotive parks for transporting pine resin to the industrial production area.
7. There is no culture for applying financial ratios to measure efficiency and deci-

sion-making.
8. Insufficiencies in the use and application of the Management Project in productive decision-making.
9. Deficiencies in project development as a tool for investment execution.
10. Company managers lack knowledge for designing competitive sources to position the product in national and international markets.

During the diagnosis, it was verified that the company is in a revival process; it was detected that it does not have the pine resin value chain, identifying the main problems in the productive process and its production flows.

DISCUSSION

This section proposes a series of steps based on expert authors to design the pine resin value chain. Once the design is considered, surveys are applied to workers involved in production and administration to identify cost- and value-generating activities, enabling competitive advantages.

Steps to propose the pine resin value chain for the Agroforestal Company of Pinar del Río:

Step 1: Establish the Work Team for the Task

A discussion of the entity's organizational structure was held to create the work team, based on each worker's experience in the forestry sector. The following structure was formed: General Director; Accounting-Financial Director; Productive Director of Technique and Development; and Principal Specialist of Silviculture and Management.

Step 2: Work plan preparation

Each activity to be fulfilled by each team member is announced. The inputs and assurances available to carry out the task are disclosed.

This step pursues two results proposed by the author: mapping productive activities related to pine resin production and designing the pine resin value chain.

Step 3: Design of educational activities to train on the value chain tool

The author proceeds to develop workshops and seminars to induce learning among forestry sector workers on the value chain as a way to manage company strategy and accounting results. Integrating the experiences of both employees and the author aims to link the chain with the product: pine resin, theoretically and practically.

Step 4: Map each key or fundamental process of the pine resin productive chain

A study is made of activities performed within the company to meticulously identify strategic, key, and support processes. This enables a critical analysis of the mission, the social objective defined by the entity, and activities related to pine resin production, specified by specialists linked to production. The above is based on the theoretical-methodological materials addressed in Chapter 1 and the concretization of educational activities in Step 3.

Step 5: Design each input of the pine resin value chain

All inputs related to product development are designed: pine resin, previously determined in the diagnosis, to select each element entering the link: inbound logistics located in primary activities and the link: procurement in support activities, intermediating throughout the value creation process.

Defined inputs for the value chain:

- Raw materials and supplies: Fuel and Lubricants.
- Work tools: Transport (Trucks); Machete; Gloves; Debarker; Hammer; Plate; Bucket.
- Human resources: workers related to resin production.
- Financial resources: bank loans and credits, transfers, feasibility studies.

- Informational resources: advisory for product extraction, product positioning for sale.

Step 6: Design the main links related to the pine resin value chain

The links related to the operations component of the value chain are designed, previously determined in the inputs. The main links are: brigade creation and extraction area definition. Meanwhile, resin collection, loading and unloading, chemical resin processing, and packaging are operational processes determined in external logistics in the generic value chain.

Step 7: Design the support links of the pine resin value chain.

Support links are outlined, harmonizing with support activities in the value chain, considering the company's technical infrastructure, accounting-financial management, planning and treasury, as well as human resources, procurement, and commercialization.

Step 8: Establish the outputs of the pine resin value chain.

A study is conducted to identify activities forming part of the outbound logistics link: resin loading and unloading, chemical resin processing, and packaging. Global outputs include those expressed in monetary values (net profit and added value), obtained by the difference between generated value and incurred cost throughout the value chain, and, on the other hand, satisfied customers. This step concludes pine resin production until each derivative (rosin and turpentine) is delivered to its clients.

Step 9: Select each client of the pine resin value chain

Clients related to product acquisition and directly linked to its value chain are identified, nourished by the previous step.

Main client: DEVOX S.A.
Other clients: UNILEVER, LABIOFAM, and the National Match Company.

Step 10: Design the pine resin value chain

This step carries out the representative design of the pine resin value chain, completing each analyzed process step, as shown in Figure 3.

Figure 3:
Pine resin value chain..

Source: Own elaboration, based on Porter (2006); López (2016); Rojas *et al.* (2021); and Rojas *et al.* (2023b).

To execute the identification of cost- and value-generating activities, a survey (Annex 1) was applied to 65 workers linked to pine resin production, yielding the following results:

- 35 surveyed workers stated that the brigade creation activity is a cost-generating activity, representing 22%.
- 41 surveyed workers established that the extraction area definition activity is a cost- and value-generating activity, equating to 12%.
- 51 surveyed workers established that the collection activity is cost-generating, equating to 14%.
- 37 surveyed workers responded that the resin loading and unloading activity is a cost-generating activity.
- 65 surveyed workers established that the chemical resin processing activity is cost- and value-generating, representing 23%.
- 60 workers defined that the packaging activity generates cost and value.

Once the survey results from production area workers were processed, the authors applied a survey to administrative area workers (30 in sample) to identify support activities generating value and cost. The results were as follows:

- 26 workers stated that the infrastructure link generates cost and value.
- 15 workers stated that the human resources link generates cost and value.
- 18 workers stated that the procurement link generates cost and value.
- 23 workers stated that the procurement link generates cost and value.

Table 1 summarizes the primary and support activities generating cost and value in the pine resin value chain.

Table 1.
Primary and support activities generating cost and value in the pine resin value chain

Actividades de la cadena de valor **Actividades Primarias**	Generadoras de costos	Generadoras de valor
Creación de la brigada	X	
Definición del área de extracción	X	X
Acopio	X	
Cargue y descargue de la resina de pino	X	
Procesamiento químico de la resina de pino	X	X
Embalaje	X	X
Actividades de Apoyo		
Infraestructura	X	X
Recursos Humanos	X	X
Aprovisionamiento	X	X
Comercialización	X	X

Source: Own elaboration according to Rojas *et al.,* (2023a)

CONCLUSIONS

Using the value chain as a technique to establish cost- and value-creating activities allows for greater competitive advantage against competitors, determining strategies to carry out the business. Pine resin production is a fundamental branch for foreign currency inflows to the country, revealing no production linkages enabling industrial value generation to implant product competition in the market.

The diagnosis of the Agroforestal company recognized the economic-financial management model, which impedes correct process design and identification of activities present in the value chain. It demonstrates that the company does not invest in the value chain as a tool for strategy development and analysis of internal company activities to establish decision-making.

The proposed procedure contributes to identifying value- and cost-generating ac-

tivities to determine future company profits generated by pine resin production and achieve sustainable accounting and financial management over time.

For better performance of the primary and support activities of the studied value chain, a series of strategic recommendations on control and improvement are integrated, as shown below:

- Study activities generating value and costs throughout the productive cycle of the chain.
- Establish business strategies for better internal coordination of company areas.
- Delve into financial analyses for correct profit planning.

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