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Original article

Technical, financial and economic feasibility of the pine sawing process in the south-central region of the state of Chihuahua, Mexico

Factibilidad técnica, financiera y económica del proceso de aserrado de Pino en la región centro-sur del estado de Chihuahua, México

Viabilidade técnica, financeira e econômica do processo de serragem de Pinus na região centro-sul do estado de Chihuahua, México

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ABSTRACT

The objective of this research was to evaluate the technical, financial, and economic feasibility of the pine sawing process in the south-central region of the state of Chihuahua, Mexico, to determine its potential as a sustainable source of income for local communities and its contribution to climate change mitigation. The results show a positive trend in cash flows, accumulating a total of 16.43 million pesos over six years. Although there were deficits in 2024 and 2029, the project quickly recovered, generating positive cash flows afterward, demonstrating an adequate capacity to cover operating costs and financial commitments with increasing revenues. Net profits reached 10.40 million pesos, consistently growing to 2.41 million in 2029, reflecting improvements in operational efficiency and profitability. The Internal Rate of Return (IRR) of 7.95% indicates that the project can recover the initial investment, and a positive Net Present Value (NPV) at a rate of 34.91% suggests that the project is viable and profitable above its capital cost. Fixed costs remain stable, and variable costs increase linearly with production. The break-even point is at 0.39 million board feet, where revenues equal total expenses. Exceeding this point is crucial for profitability. The project's average sustainability is acceptable, with an average annual profit of approximately $500,000.00, indicating that despite fluctuations, the project can maintain consistent profitability with efficient management.

Keywords: pine sawing, economic feasibility, financial feasibility, operational efficiency, sustainable income.

RESUMEN

El objetivo de esta investigación fue evaluar la viabilidad técnica, financiera y económica del proceso de aserrado de pino en la región centro-sur del estado de Chihuahua, México, para la determinación de su potencial como fuente sostenible de ingresos en las comunidades locales y su contribución a la mitigación del cambio climático. Los resultados muestran una tendencia positiva en los flujos de efectivo, acumulando un total de 16.43 millones de pesos en seis años. Aunque hubo déficits en 2024 y 2029, el proyecto se recuperó rápidamente, generando flujos positivos posteriormente,

demostrando una capacidad adecuada para cubrir costos operativos y compromisos financieros con ingresos crecientes. Las utilidades netas alcanzaron 10.40 millones de pesos, creciendo consistentemente hasta llegar a 2.41 millones en 2029, reflejando mejoras en eficiencia operativa y rentabilidad. La Tasa Interna de Retorno (TIR) del 7.95% indica que el proyecto puede recuperar la inversión inicial, y un Valor Actual Neto (VAN) positivo a una tasa del 34.91% sugiere que el proyecto es viable y rentable por encima de su costo de capital. Los costos fijos se mantienen estables y los costos variables aumentan linealmente con la producción. El punto de equilibrio se sitúa en 0.39 millones de pies tabla, donde los ingresos igualan los egresos. Superar este punto es crucial para la rentabilidad. La sostenibilidad promedio del proyecto es aceptable, con una utilidad media anual de aproximadamente $500,000.00, lo que indica que, pese a las fluctuaciones, el proyecto puede mantener una rentabilidad constante con una gestión eficiente.

Palabras clave: aserrado de pino, viabilidad económica, viabilidad financiera, eficiencia operativa, ingresos sostenibles.

RESUMO

O objetivo desta pesquisa foi avaliar a viabilidade técnica, financeira e econômica do processo de serragem de pinho na região centro-sul do estado de Chihuahua, México, a fim de determinar seu potencial como fonte de renda sustentável para as comunidades locais e sua contribuição para a mitigação das mudanças climáticas. Os resultados mostram uma tendência positiva nos fluxos de caixa, acumulando um total de 16,43 milhões de pesos ao longo de seis anos. Embora tenha havido déficits em 2024 e 2029, o projeto se recuperou rapidamente, gerando fluxos de caixa positivos subsequentes, demonstrando capacidade adequada para cobrir custos operacionais e obrigações financeiras com receitas crescentes. O lucro líquido atingiu 10,40 milhões de pesos, crescendo consistentemente para 2,41 milhões de pesos em 2029, refletindo melhorias na eficiência operacional e na rentabilidade. A Taxa Interna de Retorno (TIR) de 7,95% indica que o projeto pode recuperar o investimento inicial, e um Valor Presente Líquido (VPL) positivo de 34,91% sugere que o projeto é viável e rentável acima do seu custo de capital. Os custos fixos permanecem estáveis, enquanto os custos variáveis aumentam

linearmente com a produção. O ponto de equilíbrio é de 0,39 milhões de pés cúbicos, onde a receita se iguala às despesas. Ultrapassar esse ponto é crucial para a lucratividade. A sustentabilidade média do projeto é aceitável, com um lucro médio anual de aproximadamente US$ 500.000,00, indicando que, apesar das flutuações, o projeto pode manter uma lucratividade consistente com uma gestão eficiente.

Palavras-chave: serragem de pinho, viabilidade econômica, viabilidade financeira, eficiência operacional, receita sustentável.

INTRODUCTION

A key challenge of industrial forest management, as described by Gilmour (2016) and Rascón-Solano *et al.* (2023), is identifying strategies that allow communities to reap all the economic benefits of their forests. In this context, the production and marketing of sawn timber and its processed products represent a significant opportunity. According to Larchenko *et al.* (2022) and Packalen *et al.* (2017), these products play an important role in climate change mitigation due to their capacity to store carbon long-term. Therefore, at a global level, promoting sustainable forest management that optimizes sawn timber production can simultaneously maximize economic benefits for local communities and contribute to climate change mitigation.

Driven by globalization, industrialization, economic growth, and population increase, global demand for wood products has grown rapidly, especially in emerging markets (Wan *et al.*, 2012). In this sense, the growth of the forestry industry is crucial for socioeconomic development, particularly in forest-dependent communities (Guettabi, 2014; Lupo, 2017; Merino Pérez, 2018). In rural areas, this industry helps generate employment, diversify production, and add value to products, thus ensuring the long-term success of businesses (Makkonen and Sundqvist-Andberg, 2017). However, in practice, a sawmill manager may lack sufficient knowledge or resources to follow all strategic management processes (Hitt *et al.*, 2003). Some of these strategies are related to the development of expansion plans or the emergence of new companies in the forestry industry.

In this regard, Rascón-Solano *et al.* (2019) recommend promoting the emergence of new industries, primarily by establishing sawmills in communities and ejidos (communal lands) through investment projects. Similarly, Rascón-Solano *et al.* (2022a) mention that the establishment of a private sawmill stimulates the local and regional economy by creating jobs and adding value to natural resources. Furthermore, the development of new businesses promotes sustainable forest management, the development of local infrastructure and skills, opens opportunities in international trade, and fosters technological innovation. However, studies determining the feasibility of establishing sawmill industries are limited (Perkins *et al.*, 2008; Scudder *et al.*, 2019) .

Considering the above, the objective of this research was to evaluate the technical, financial, and economic viability of the pine sawing process in the south-central region of the state of Chihuahua, Mexico, in order to determine its potential as a sustainable source of income for local communities and its contribution to climate change mitigation. The hypothesis states that the pine sawing project in the south-central region of the state of Chihuahua is economically viable and profitable, as it can generate positive and increasing cash flows and is expected to achieve positive results in the established financial indicators.

MATERIALS AND METHODS

Studio location

The proposed industrial facility for this study is located in the south-central region of the state of Chihuahua. It lies within the Sierras y Llanuras del Norte (IV) physiographic province, specifically the Bolsón de Mapimí subprovince. The climate is very dry and semi-warm with summer rainfall [BWhw (x)]. The average annual temperature ranges from 18° to 22°C, and the coldest month has an average temperature below 18°C. The predominant soils are Calcisol, Chernozem, Kastanozem, and Leptosol (National Institute of Statistics and Geography [INEGI], 2022). The municipality of Guachochi is considered as a potential source of raw materials. This municipality is located within the Sierra Madre Occidental (III) physiographic province, specifically the Gran Meseta y Cañones Chihuahuenses subprovince. The municipality features an uneven-aged cold

temperate forest (pine, pine-oak and oak-pine) with diverse forest species and Cambisol soil association Eutric, Planosol Eutric and Eutric Regosol, with a medium to fine texture [INEGI], 2014); the predominant climate for the region is semi-cold humid [C(E)(w2)(x')], the average annual temperature between 5° and 12°C and an average annual precipitation of 621.3 mm [INEGI], 2008).

Technical methodological procedure

To begin processing operations, it is necessary to purchase a property with suitable characteristics for storing raw materials and timber products. Additionally, the installation of an electrical system, sawmill equipment, offices, and an industrial building is required. The sawmill is expected to operate for an estimated period of 288 days, with eight-hour shifts. The sawmill operation will require the hiring of 13 people to perform technical, administrative, operational, and security duties. Daily production is estimated at 5,000 board feet (ft) with an annual consumption of 1,440,000 ft, except for year zero (2024), in which a net consumption of 432,000 ft is projected. The raw material to supply the industry will be obtained from private properties and ejidos that market their standing timber in the municipality of Guachochi; the suppliers considered consolidated a "purchase-sale" contract for forest raw materials during the spring of 2024.

Financial-economic methodological procedure

To develop the financial and economic analyses, it was necessary to investigate the costs of properties, transformation equipment, the cost of the electrification system and the cost of the buildings, to obtain the fixed cost; the raw materials, the costs involved in relation to the payment of payrolls and wages to determine the variable costs of the project; and the prices of the product to be marketed to estimate the income.

Based on the above, it is necessary to evaluate the investment to be made using the methodology for formulating and evaluating investment projects proposed by Baca-Urbina (2013). This method indicates the need to estimate the Net Present Value (NPV), the Internal Rate of Return (IRR), and the Benefit/Cost Ratio (B/C Ratio) of the project. These parameters were evaluated based on an Average Annual Rate of Return (AAR) of

12.00%, in accordance with the recommendations of previous studies of the same nature as this research (Rascón-Solano *et al*., 2022a; Rascón-Solano *et al*., 2022b).

The Net Present Value (NPV) calculation allows for the consideration of cash flow over time (Hernández-Díaz *et al*., 2011). The equation shown below illustrates the procedure for calculating this indicator:

$$VAN = -I_0 + \sum_{t=1}^{n} \frac{Ft}{(1+k)^t} = -I_0 + \frac{F1}{(1+k)} + \frac{F2}{(1+k)^2} + \ldots + \frac{Fn}{(1+k)^n}$$

Where: $-I_0$ = Initial investment; F = Cash flow per period; $(1 + k)$ = Discount factor for cash flows; and n = Project horizon.

Internal Rate of Return (IRR) is the interest rate or profitability offered by an investment (Arreguín-Sámano *et al*., 2014). This study proposes to evaluate this indicator using an Average Annual Rate of Return (AAR) of 12.00%. The procedure for calculating this rate is shown below:

$$TIR = \sum_{t=0}^{n} \frac{Fn}{(1+i)^n} = 0$$

Where: Fn = Cash flow in period n; n = Project horizon; and i = Discount rate.

Aguilera-Díaz (2017) points out that the B/C Ratio is the index that is defined as the relationship between the benefits and the costs or expenses that are generated by a project and is estimated with the following relationship:

$$Rel.\ {}^{B}/_{C} = \frac{\sum_{j=0}^{n} \frac{B_j}{(1+i)^n}}{\sum_{j=0}^{n} \frac{C_j}{(1+i)^n}}$$

Where: B_j = Positive net flow of period j; C_j = Negative net flow of period j ; i = Investment discount rate; and, n = Project horizon.

As part of the economic analysis of this project, it is proposed to estimate the Break-Even Point (BEP) and the Payback Period (PP). Rascón-Solano *et al*. (2022b) indicate that to evaluate industrial investment projects it is important to calculate the Break-Even Point, since it is an index that determines the quantity of product sold to cover the invested costs:

$$P.E. = \frac{CF}{P - CV}$$

Where: *CF* = Fixed Costs; *P* = Unit Price; and *CV* = Unit Variable Costs.

The payback period is frequently used in economic evaluations of investment projects. Rascón-Solano *et al*. (2022a) mention that this indicator provides an estimate of the time it will take for the initial investment to be recouped through profits from the sale of sawn timber. The equation shown below is used to calculate this index:

$$P.R. = \sum_{n=0}^{Tp} \frac{F_j}{(1 + i)^n}$$

Where: *Tp* = Payment time; F_j = Net flow of period *j*; *i* = Discount rate; and *n* = Project horizon.

RESULTS AND DISCUSSION

Raw material costs

Negotiations with four ejidos (communal landholdings) and three private properties established the compensation items, based on the activities necessary to fell, extract, and supply the pine raw materials. In the southeastern region of the state of Chihuahua, it is still common to market logs using the Doyle Foot (DF) concept, where the price of standing timber is the highest-value item ($12.00 per DF). Rascón-Solano *et al*. (2022b) do not recommend using this volume calculation method in the country's timber activities because it is inaccurate and should only be used as a method for estimating timber production. Furthermore, the payment item that presented a high cost was the

transportation of the raw material from the municipality of Guachochi to the municipality of Rosales, both in the state of Chihuahua; this item was contracted at $3,500.00 per thousand DF, equivalent to $741.53 per m³. Considering the total cost, an expenditure of $4,025.42 per m³ of roundwood delivered to the yard in the south-central region of the state is estimated (Table 1). Rascón-Solano *et al.* (2022a) , on the other hand, estimated significantly lower prices for the municipality of Guachochi, with an estimated cost of $1,525.42 per m³, meaning that the raw material in this analysis is 2.64 times more expensive than in 2019. Regmi, meanwhile, *et al.* (2022) estimated a price of $2,793.88 per m³ for the southeastern region of the United States during the period 2013-2018, indicating a lower price than that presented in this study.

Table 1. *- Estimated costs for the purchase of pine raw material delivered directly to the supply yard in the south-central region of the state of Chihuahua from the municipality of Guachochi*

Concept	**Cost of the activity ($)**		
	Pie Doyle	**Millar Pie Doyle**	**Cubic meter (m³)**
Standing wood	12.00	12,000.00	2,542.37
Demolition and cutting	0.75	750.00	158.90
Forest cleaning	0.50	500.00	105.93
Drag, join and load	1.50	1,500.00	317.80
Documenter and hunter	0.25	250.00	52.97
Road planning	0.50	500.00	105.93
Freight of a log to the municipality of Rosales	3.50	3,500.00	741.53
Total Costs	19.00	19,000.00	4,025.42

Administrative and service costs

The costs associated with payroll and wages were estimated at a total of 0.89 cents per unit processed. In this regard, payments for specialized and administrative services are the highest, representing an investment of $87.34 per thousand units, as shown in Table 2. Relating this cost to the estimated daily production, net payments of $436.70 are expected after deductions for Income Tax, Medical Services, and Employee Allowance. Sorenson *et al.* (2015) estimated the average daily pay for softwood (pine) sawmill workers in the United States, with the median wage being $1,543.86 within a range of $1,035.59 to $1,864.06. This estimate indicates that wages for the forestry industry in the United States are at least 3.53 times higher compared to the highest wages described here.

Table 2. *- Estimated costs for specialized technical services, administrative services, operating wages and security services*

Concept	Cost of the activity ($)		
	Table Foot	Thousand Foot Table	Cubic meter
Forestry technical service	0.09	87.34	18.52
Industrial specialist	0.09	87.34	18.52
Administrative Specialist	0.09	87.34	18.52
Production Manager	0.09	87.34	18.52
Sawing foreman	0.09	87.34	18.52
Wheeler	0.05	52.41	11.11
Sawyer	0.09	87.34	18.52
Tumbler	0.05	52.41	11.11
Edger	0.05	52.41	11.11
Header	0.05	52.41	11.11
Sawn timber classifier	0.05	52.41	11.11
Stacker	0.05	52.41	11.11
Vigilant	0.05	52.41	11.11
Total Costs	0.89	890.91	188.87

Value of equipment and infrastructure

The incorporation of traditional sawmill equipment was considered to facilitate the transformation processes, including a Mexican-made NEKS main tower with flywheels for a 6-inch-wide slab, a transformation platform with a 16-foot-long square carriage, and a three-head resaw, all from the NEKS brand. This machinery allows for multiple cuts and accelerates production processes. The infrastructure consists of a 10 m x 30 m building constructed with IPR steel beams and GR100 galvanized sheet metal, with a 12.5 cm thick concrete floor. It includes a 300 kW Voltran three-phase transformer with optional 220 V and 440 V inputs, valued at MXN 70,760.00. The total cost of the project, including infrastructure and sawmill equipment, is MXN 1,448,738.88 with an annual depreciation of 12%, reaching a residual value of MXN 579,495.55 at the end of five years (Table 3).

Table 3. *- Value of sawing equipment and infrastructure costs*

Concept	Cost of the concept ($)		
	Amount	**Unit value**	**Accumulated value**
Property of 10,000 m²	1	650,000.00	650,000.00
Office equipment	1	59,653.88	59,653.88
Infrastructure and electrification	1	100,000.00	100,000.00
Transformer	1	70,760.00	70,760.00
Main tower for 6- inch tape	1	215,000.00	215,000.00
Three-squad wagon and track	1	190,000.00	190,000.00
Edger	1	68,500.00	68,500.00
Vertical pendulum	5	6,800.00	34,000.00
Protective equipment	15	830.67	12,460.00
Firefighting equipment	5	1,033.00	5,165.00
Six 10-foot role-playing tables	6	7,200.00	43,200.00
Total Costs	31		1,448,738.88

Value of sawn products

The 6/4-inch board class stands out as the highest-earning class, generating $313,056.00. This result is due to its high production volume, which represents 21.74% of the total distribution. The high production proportion of this class, combined with its value per board foot, allows this category to dominate revenue, making a substantial contribution to the overall profit of the sawmilling process.

On the other hand, Class 2 and better 7/8-inch boards are the highest-value class per board foot, priced at $33.68. However, their contribution to total revenue is relatively low, reaching only $39,024.00, which represents 2.71% of the distribution. This discrepancy is due to their lower production volume, which limits their impact on total revenue despite their high unit value.

Classes 3 and 4 of 7/8-inch boards and the 5/4-inch plank offer a good balance between value and production volume, contributing significantly to total revenue. These classes combine a moderate value per board foot with a significant proportion of production, allowing them to contribute effectively to overall profit (Table 4). This mix of value and

volume ensures a solid revenue base, highlighting the importance of maintaining a diversified and balanced production.

According to Rascón-Solano et al. (2022a), sawn timber prices in northern Mexico for 2019 were projected from an unclassified product base. Class 2 and higher timber had a value of MXN 18.68 per piece, followed by Class 3 at MXN 14.65 per piece. Class 5 timber had the lowest value at MXN 9.29 per piece. Comparing the results of this study, sawn timber increased in cost by an average of 1.77 times over five years. Class 5 timber increased in value by 2.08 times, followed by Class 3, which increased its market price by 1.91 times. In contrast, beams and joists increased in market value by only 1.45 times. This is mainly due to the increase in forest commodity prices as projected following the COVID-19 contingency, in a timber market that was already under increasing pressure (Rascón-Solano *et al.*, 2022); likewise, the Russian invasion of Ukraine had a significant impact on global economic prospects, generating disruption in the timber supply chain, derived from sanctions and trade restrictions, where the global sawn timber price index decreased by 63%, despite the significant drop, the index reached maximum values when considering the period up to 2020 (Picos, 2022).

Table 4. *- Value of sawn products expected to be generated*

Measurement (Inch)	Class of sawn timber	Table Foot Value ($)	Distribution (%)	Income
7/8	Class 2 and Better	33.68	2.71	39,024.00
	Class 3	28.02	13.53	194,832.00
	Class 4	23.48	18.94	272,736.00
	Class 5	19.29	18.94	272,736.00
5/4	5/4 Board	23.48	14.50	208,800.00
6/4	6/4 Board	19.29	21.74	313,056.00
3 ½	Purlin and beam	19.29	9.64	138,816.00
Total Benefit			100.00	1,440,000.00

Calculated cash flows

Regarding total revenue, the project has accumulated 186.76 million pesos during the period analyzed. Annual revenue shows steady growth, starting at 9.62 million pesos in 2024 and reaching 38.97 million pesos in 2029. This increase reflects a gradual and sustained expansion in revenue-generating capacity.

Total expenditures amount to 170.33 million pesos over the period. Similar to revenues, annual expenditures also increase, rising from 10.15 million pesos in 2024 to 35.24 million pesos in 2028. This growth in operating costs is typical of an expanding project, but it remains controlled relative to the increase in revenues.

The total cash flow is positive, accumulating 16.43 million pesos over the six years. After a negative cash flow of -0.53 million pesos in 2024, the project shows a rapid recovery, generating positive cash flows in subsequent years, reaching 3.73 million pesos in 2029. This change indicates a significant improvement in the project's ability to generate sufficient cash to cover its operating costs and other financial obligations.

Regarding taxes paid, the total amounts to 6.03 million pesos over the period. Annual taxes increase in line with the increase in profits, from 0.05 million pesos in 2024 to 1.32 million pesos in 2029, reflecting the growth in the project's profitability.

Net profits totaled 10.40 million pesos. Despite starting with a net loss of -0.58 million pesos in 2024, net profits grew consistently in subsequent years, reaching 2.41 million pesos in 2029. This continuous increase in net profits underscores the improvement in operational efficiency and the project's ability to generate benefits (Table 5).

Table 5. *- Calculated cash flows for establishing the sawmill*

Annuity	**Year**	**Concepts expressed in millions of pesos MN ($)**				
		Income	**Expenses**	**Cash flow**	**Taxes**	**Utilities**
2024	0	9.62	10.15	- 0.53	0.05	- 0.58
2025	1	32.06	28.99	3.07	1.08	1.99
2026	2	33.66	30.44	3.22	1.14	2.09
2027	3	35.34	31.96	3.38	1.19	2.19
2028	4	37.11	33.56	3.55	1.25	2.30
2029	5	38.97	35.24	3.73	1.32	2.41
Totals		186.76	170.33	16.43	6.03	10.40

The pine sawmilling project in the south-central region of the state of Chihuahua, covering the period from 2024 to 2029, shows significant fluctuations in annual income and expenses. Expenses range around 2 million pesos, reaching peaks of up to $5,216,324.83 and $5,701,797.77 in 2027 and 2029, respectively. Income shows a linear trend, with highs exceeding 3.0 million pesos. These variations impact cash flow, which shows periods of deficit, especially in 2024 and 2029, and other periods of solvency. These fluctuations are related to the projected monthly supply rates. Despite these fluctuations, the average profit remains relatively constant at around $500,000.00 annually, indicating an acceptable average sustainability of the project over time (Figure 1a).

Figure 1b shows the relationship between the estimated rate of return (%) and the net present value (NPV) in millions of pesos, highlighting the line that intersects the profitability curve at the NPV and the Internal Rate of Return (IRR). This point of intersection is fundamental for the project's viability analysis, since an IRR of 7.95% means that, at this rate of return, the NPV is zero. This implies that the project generates sufficient income to exactly cover the initial investment, without producing profits or incurring losses. This result defines the IRR as the minimum threshold for project viability: any rate of return below this would result in a negative NPV, indicating that the project is not financially sustainable.

Additionally, the graph shows that at a higher rate of return of 34.91%, the NPV is positive, demonstrating that the project is capable of generating significant additional profitability above the minimum threshold established by the IRR. This scenario shows that, as the rate of return increases above 7.95%, the project not only covers its costs but also produces significant net profits, reinforcing its financial attractiveness.

The relationship between IRR and NPV highlighted in this graph is essential for financial decision-making. An IRR that significantly exceeds the opportunity cost of capital indicates a robust and financially attractive project. This highlights the importance of not only reaching but also surpassing this minimum profitability threshold to ensure not

only the recovery of the initial investment but also the generation of long-term added value.

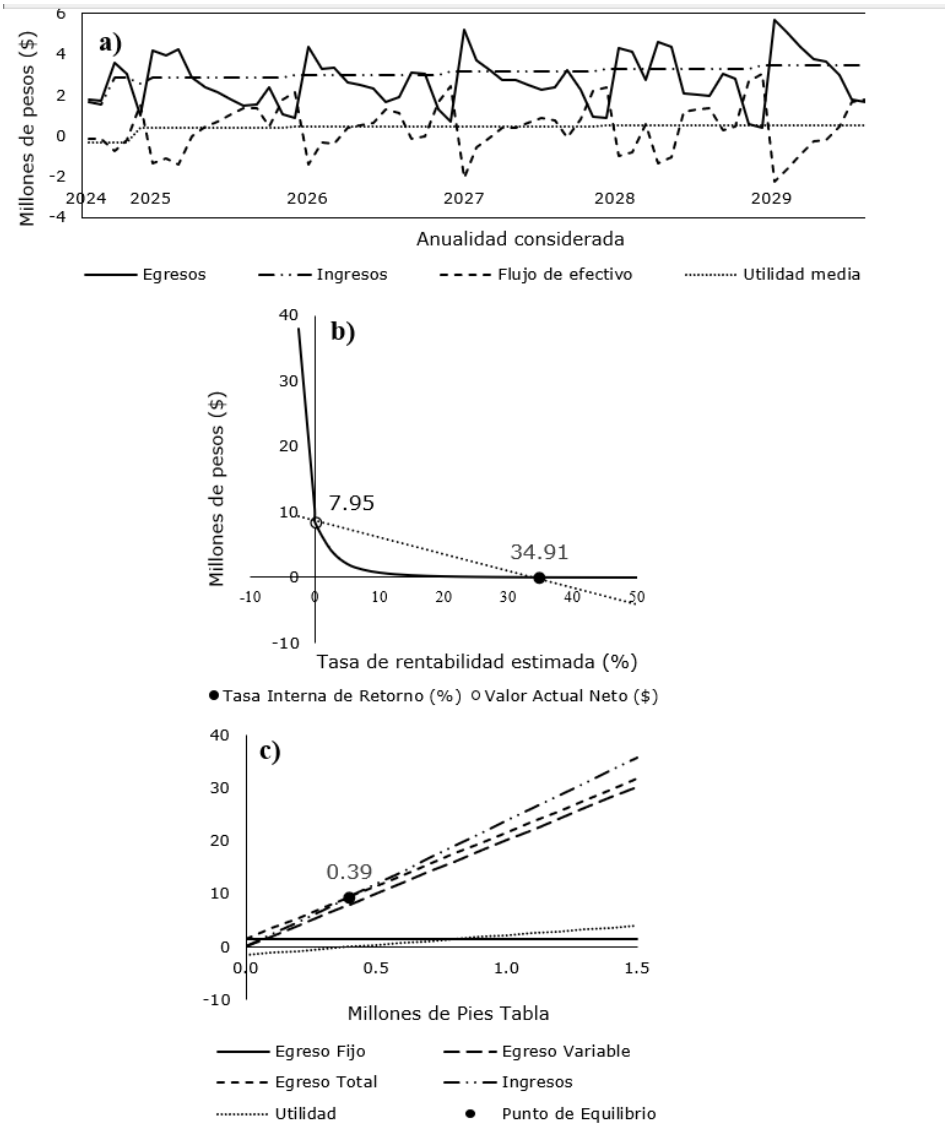

Figure 1. *- Financial and economic indicators of the sawmill project*

Figure 1c presents a detailed relationship between the income, expenses, and profit of the pine sawmill project, based on production measured in millions of board feet. Fixed expenses remain constant at approximately 1.45 million pesos, with no variation with respect to the production level. In contrast, variable expenses show a linear increase with increasing production, reflecting the additional costs associated with higher levels of productive activity. The sum of fixed and variable expenses constitutes total expenses, which have an upward slope on the graph.

The revenue line also shows a linear upward trend with respect to production, indicating that the project is capable of generating higher revenues as production volume increases. The break-even point, located at 0.39 million board feet, is crucial for the project's economic viability. At this point, revenues equal total expenses, indicating that the project generates neither net profit nor loss. Exceeding this break-even point is essential for the project's profitability, as any increase in production beyond this threshold results in a positive profit, as indicated by the upward-sloping profit line after the break-even point.

The graphical representation allows for a clear visualization of the distinction between fixed and variable costs, and how these relate to the revenue generated at different production levels. This analysis highlights the importance of reaching and exceeding the break-even point to ensure the project's economic sustainability. Furthermore, it demonstrates the need for efficient management to maintain production levels above this threshold, thereby ensuring the project's ability to generate significant net profits in the long term.

CONCLUSIONS

The project's cash flows show an overall positive trend, accumulating a total of 16.43 million pesos over the six years analyzed. Despite periods of deficit in 2024 and 2029, the project recovers quickly and generates positive cash flows in subsequent years. This indicates an adequate capacity to cover operating costs and financial commitments, supported by a gradual and sustained increase in revenue. The project's net income reaches a total of 10.40 million pesos. Although it begins with a net loss in 2024, profits show consistent growth, reaching 2.41 million pesos in 2029. This increase reflects significant improvements in the project's operational efficiency and profitability as production and revenue increase.

The Internal Rate of Return (Rascón-Solano *et al.*, 2022) for the project is 7.95%, indicating the financial break-even point where the Net Present Value (NPV) is zero. This means the project can recover the initial investment at this rate of return. Furthermore, the NPV

becomes positive at a rate of return of 34.91%, demonstrating that the project is not only viable but can also generate substantial profits above its cost of capital.

The project has clearly defined fixed and variable costs. Fixed costs remain stable, while variable costs increase linearly with production. The break-even point is 0.39 million board feet, where total revenue equals total expenses. Exceeding this point is crucial for the project's profitability, as net profits begin to be generated from this point onward. The project's average sustainability is acceptable, with an average profit of approximately $500,000 annually. This suggests that, despite annual fluctuations in revenue and expenses, the project can maintain consistent profitability over the period analyzed. Efficient management is essential to keep production above the break-even point and ensure continuous profit generation.

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The authors have participated in the writing of the work and analysis of the documents.