



Assessment of the production costs and economic viability of pecan nut production: Assessment of a case in Rio Grande do Sul, Brazil

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ABSTRACT: The production of pecan [*Carya illinoensis* (Wangenh.) K. Koch] is increasing in Brazil, especially in the Rio Grande do Sul, which accounts for approximately 70% of the country's production. The importance of pecan farming for the state, particularly for the southern half, which is characterized by extensive livestock farming and the monoculture of rice and soybeans, is related both to the possibility of increasing diversification and to the aggregation of extra income in rural areas. In this context, this research estimated the production costs and economic viability of a small family property, which is the common scale of pecan production in the Rio Grande do Sul. The production costs were collected from a real farm for a 7-year period, and then projected until the 30th year. All the monetary values were updated for June 2022, and the production cost methodology determined by the Companhia Nacional de Abastecimento (CONAB) was adopted. The results showed that the enterprise was not economically viable over a 30-year horizon. However, with a 23.62% increase in average productivity or a 21.51% increase in the real selling price, the enterprise reaches the break-even point in the analyzed period.

Key words: *Carya illinoensis*, Pecan, Pecan farming, economic viability, diversification.

Avaliação dos custos de produção e da viabilidade econômica da produção de noz-pecã: Avaliação de um caso no Rio Grande do Sul, Brasil

RESUMO: A produção de noz-pecã encontra-se em crescimento no Brasil, especialmente no Rio Grande do Sul, que responde por aproximadamente 70% da produção do país. A importância da pecanicultura para o Estado, particularmente para a metade sul, que desenvolve uma pecuária extensiva e a monocultura do arroz e da soja, está relacionada tanto com a possibilidade de aumento da diversificação, quanto com a agregação de uma receita extra nas propriedades rurais. Neste sentido, este trabalho teve como objetivo estimar os custos de produção e a viabilidade econômica de uma pequena propriedade familiar, produtora de noz-pecã em nível comercial no Rio Grande do Sul. Os custos de produção foram levantados pelo período de sete anos e projetados até o trigésimo ano. Os valores monetários foram atualizados para o mês de junho de 2022 e adotou-se a metodologia de custos de produção determinada pela Companhia Nacional de Abastecimento – CONAB. Os resultados demonstraram que o empreendimento não foi economicamente viável no horizonte de 30 anos. Entretanto, concluiu-se que com um aumento de 23,62% na produtividade média ou de 21,51% no preço de venda o empreendimento atinge o ponto de equilíbrio no período analisado.

Palavras-chave: *Carya illinoensis*, noz-pecã, Pecanicultura, viabilidade econômica, diversificação.

INTRODUCTION

The cultivation of pecan [*Carya illinoensis* (Wangenh.) K. Koch] has been gaining prominence in Brazil, driven by the increase in the demand for healthy foods and the appreciation of the product in the market. According to the Brazilian Association of Nuts, Chestnuts and Dried Fruits (ABNC, 2021), in 2019, Brazil was the 4th largest producer in the world, with a production of 3,500 tons, with Rio Grande do Sul being responsible for approximately 70% of total production. It is estimated that the cultivated area in the country is close to 10 thousand hectares (MARTINS et al., 2023a).

In Rio Grande do Sul, the activity is present in all regions, with the main production and industrialization hubs being located in the municipalities of Anta Gorda and Cachoeira do Sul (SEAPDR, 2020). According to MARTINS et al. (2017), cultivation has become attractive due to the prices paid for the product and the possibility of growing pecans in agroforestry systems which integrate crops, livestock and forestry. This type of system has advantages such as the sustainable use of natural resources, as it preserves the soil, favors the preservation of fauna and flora, and reduces the investment risk of monocultures due to the diversification of economic activities on the property (SCHEMBERGUE et al., 2017; LAURA et al.,

2021). Furthermore, pecan culture can contribute to family succession in the countryside, developing nut processing industries and agribusinesses producing sweets and other products, in addition to being an opportunity for the metalworking industry through the supply of machines and implements for the sector (SEAPI, 2017). The state has the potential to expand and consolidate pecan culture since production is still insufficient to meet the demand of the domestic market, as the country has been supplied through imports so far (BILHARVA et al., 2018).

In this context, to stimulate and support the structuring, organization and development of the pecan production chain, some government programs and several projects from organizations such as the Brazilian Agricultural Research Corporation (EMBRAPA), the Technical Assistance and Rural Extension Company (EMATER), the Brazilian Pecan Farming Institute (IPBecan) and universities have been prepared. Furthermore, research carried out in recent years has contributed to various aspects of cultivating pecans, such as their agronomic characteristics, technologies used, pruning, productivity and quality, pests and diseases and health benefits (DE MARCO et al., 2021; MARTINS et al., 2023b; ROLIM et al., 2022; COGAN et al., 2023). However, few studies have been conducted to investigate the economic capacity of this activity. CAMARA et al. (2019) demonstrated that the activity is economically viable, with a return rate of more than 14% per year, but investments in improvements and equipment, which are essential production factors in the implementation of orchards for commercial purposes, were not considered in the analysis.

As pecan cultivation is a productive activity that is still in consolidation and that is mainly composed of family farmers who cultivate pecan nuts on properties with areas ranging from 4 to 15 hectares (MARTINS et al., 2017; CROSA et al., 2020), this research analyzed the economic viability of pecan production on representative rural property in Rio Grande do Sul.

MATERIALS AND METHODS

Selection and characterization of the production unit

The definition of the property used as a reference in this research followed a series of criteria previously discussed with 1 researcher and 4 experts in the activity in the state. With the support of these professionals, belonging to IBPecan and Embrapa Clima Temperado, the following criteria were chosen

for the reference property: (01) size of the property (pecan production area similar to the average area of pecan producers in Rio Grande do Sul), (02) use of predominantly family labor, (03) technology used (carrying out cultural management and treatments recommended by the development and research institutions), and (04) willingness and interest (owner's willingness to participate in the research, providing all information about the production and commercialization of pecans on the property).

The production unit used as a reference was a family-based property located in the central depression region of the state, with an area of 13.75 hectares and with 7 hectares dedicated to the production of pecan nuts. The orchard has a density of 100 plants per hectare, and the seedlings were acquired from nurseries registered with the Ministry of Agriculture, Livestock and Supply; 70% of the plants were from the main cultivar, and 30% were from pollinating cultivars. The owner controlled pests and diseases, used irrigation, fertilized plants and soil based on chemical analyses of leaves and soil, controlled invasive species, carried out recommended pruning, prepared the orchard for harvest, and performed other treatments essential for the adequate development of the orchard.

Survey and methodology for analyzing production costs

The investments, costs and expenses were obtained and tabulated up to the seventh year of the orchard's implementation, according to the records available on the property. As practices, management and cultural treatments from a certain stage of plant development are repeated annually, varying only in quantity and frequency; from the eighth year of orchard implementation until the thirtieth year, the practices are repeated. All data provided by the producer, as well as projected data, were checked by a technical consultant working in several production centers and another linked to EMBRAPA.

To classify production costs, investments in improvements, machinery and equipment, depreciation and opportunity costs, the production cost methodology determined by Conab was adopted (CONAB, 2010). For calculation purposes, the land was considered owned, and payments were made in cash.

To estimate production, the productivity of the existing orchard on the property, which was implemented in 2009, was considered. Considering the productive alternation characteristic of this

culture (MADERO et al., 2017), from the 14th onward, a production of 2,500 kg/ha was projected for the “ON” years and a 15% reduction for the “OFF” years.

The costs of labor and machinery were calculated in hours, considering the average daily and machine-hour values for the region. For the opportunity cost of the land, the value received for leasing soybeans was considered (9 bags per hectare, corresponding to R\$ 1,632.33/ha on 06/23/2022). For the producer’s remuneration for managing the property, a salary of R\$ 1,212.00/month was allocated (BRASIL, 2022), consistent with the expected remuneration for a family farmer in the region where the reference property is located. The selling price of pecan nuts in shell was R\$13.91/kg, which corresponds to the average price received by the producer in the harvest from 2022. In addition, two companies in the region were consulted in June 2022 and reported average prices ranging between R\$12.00 and R\$14.00.

Economic viability indicators

To analyze economic viability, a cash flow projected for 30 years was used. The net present value (NPV) can be generated from the cash flow using a minimum attractive rate of return (MARR), representing the opportunity cost of capital, which in this study was 7.70% per year, based on the correction of savings between the months of November 2021 and November 2022. This financial indicator represents the sum of projected cash flows, discounting them from the MARR, according to the following formula:

$$NPV = -C_0 + \frac{C_1}{1+r} + \frac{C_2}{(1+r)^2} + \dots + \frac{C_T}{(1+r)^T}$$

where “C” is the cash flow for the period, “r” is the discount rate and “T” is the total investment evaluation period.

Since it is an unconventional cash flow in which cash outflows and inflows alternate (positive and negative cash flows) during the life of the project (ASSAF NETO & LIMA, 2014), investment analysis was based on NPV analysis. In this case, the literature states that the internal rate of return (IRR) should be viewed with caution because the investment analyzed possesses more than one IRR; in other words, in this case, the IRR does not reliably represent the exact measure of the return of the investment analyzed (BARBIERI et al., 2007; FERREIRA FILHO et al., 2021).

RESULTS AND DISCUSSION

The inventory of existing property improvements, as well as the respective annual depreciation, are described in table 1. The list of agricultural machinery and implements purchased for the enterprise and their annual depreciation are presented in table 2.

The income resulting from the commercialization of the production of 700 pecan trees is detailed in table 3. As expected, productivity in the initial years was low. Between the 7th and 9th years, an average annual productivity of 248.33 kg/ha was reached. From the 10th to the 13th years, the average annual productivity reached 1,258.69 kg/ha. From the 14th year onward, an average annual productivity of 2,323.53 kg/ha was projected, an estimate based on the productivity achieved in the 12th year, an “ON” year, of one of the property’s orchards. According to FRONZA & HAMANN (2016), in commercial adult orchards with adequate management, productivity can reach 2,000 to 3,000 kg/ha. However, FILIPPIN (2012) reported an average annual productivity of 12,852 kg/ha between the 14th and 20th years of production

Table 1 - Investments in improvements and depreciation on a 13.75 ha property in the state of Rio Grande do Sul, prices as of June 2022.

Improvements	Qty	Total (R\$)	life cycle (years)	Residual value (%)	Depreciation R\$/year
Fence (m)	1,500	16,263.00	25	20	520.42
Warehouse (wood) (m ²)	7.5	2,000.00	25	20	64.00
Concrete pole	1	828.07	35	20	18.93
Water pump house (brick)(m ²)	17.5	11,740.00	40	20	234.80
Electrical network (m)	850	13,200.00	40	20	264.00
Water reservoir (ha)	0.6	39,800.00	50	20	636.80
Total		83,831.07			1,738.95

Table 2 - List of agricultural machinery and implements and depreciation on a 13.75-ha property in the state of Rio Grande do Sul, prices as of June 2022.

Machines/equipment	Qty	Unit Price (R\$)	Total (R\$)	life cycle (years)	Residual value (%)	Depreciation R\$/year
Manual backpack sprayer 20 L	1	142.33	142.33	5	0	28.47
Motorized sprayer 14 L	1	1,444.00	1,444.00	5	0	288.80
Sprayer tank 600 L	1	68,500.00	68,500.00	10	10	6,165.00
Moisture meter	1	1,834.80	1,834.80	10	10	165.13
Seeding machine 800 L	1	10,750.00	10,750.00	15	20	573.33
Loader shell	1	9,500.00	9,500.00	10	25	712.50
Chainsaw – 61 cm	1	2,146.73	2,146.73	10	10	193.21
Trimmer	1	4,883.67	4,883.67	8	5	579.94
Tractor's back brush cutter	1	17,500.00	17,500.00	12	5	1,385.42
Nut collecting globe	2	405.13	810.26	5	20	129.64
Nutcracker	1	150.00	150.00	5	20	24.00
Pruning tools	1	824.42	824.42	5	20	131.91
Water tank	2	400.00	800.00	10	0	80.00
Irrigation system (microsprinkler)	1	112,000.00	112,000.00	20	20	4,480.00
Producer's car	1	10,315.00	10,315.00	5	20	1,650.40
Massey Ferguson 250 compact Tractor – 2010*	1	61,386.00	-	10	20	106.76
Other equipment	1	165.00	165.00	10	10	14.85
Total			241,766.21			16,709.35

*The Massey Ferguson 250 compact Tractor – 2010, supplied by the producer's association, was valued according to the Fipe table and depreciated at a rate of 20%, and the residual value was divided by the number of members. The value of the machine was not included in capital assets, and only its depreciation was used in costs.

in an orchard with a density of 204 plants per hectare, contradicting the values reported by the main research organizations on culturing in Rio Grande do Sul.

Table 4 presents the fixed and variable costs, revenues, and opportunity costs of the land, referring to a 7-hectare orchard, in years zero, 7th year, 14th year, 21st year, 28th year and 30th year. From these data, the production cost and the producer's income were obtained. The average total cost per hectare for the years analyzed was R\$ 18,353.69, and the average annual income was R\$ 68,536.28.

Table 4 shows that from the 14th year onward, when production stabilized, the sales price/kg of R\$ 13.91 exceeded the production cost/kg. It is also possible to observe that from the 14th year onward, the producer starts to have positive results and income. It is worth noting that the most commonly used supplies by crops, such as nitrogen, phosphorus and potassium, as well as fuels, significantly increased during the period analyzed in this study, directly impacting production costs.

The economic viability of the reference property was based on total revenues, investments, fixed costs and variable costs for the production of a 7-hectare orchard, as shown in tables 5, 6, 7, 8 and 9. These data were organized into a cash flow for a period of 30 years. The initial investment for the implementation of 700 trees in an area of 7 hectares was R\$ 324,711.57 (Table 5), considering improvements, irrigation systems and their components, fixed costs, variable costs and operational expenses. Of this value, 54.9% refers to the irrigation system and the improvements made to the irrigation system.

Considering the initial investment of R\$ 324,711.57 for the implementation of the orchard and the cash flows applied at a MARR of 7.70% per year, for a period of 30 years, a negative NPV of R\$ - 223,142.86 was obtained. Unlike the results of CAMARA et al. (2019), who obtained a positive result, with an NPV of R\$ 565,410.58 over 30 years, the results of this study were negative. Furthermore, FILIPPIN (2012), analyzing the

Table 3 - Production, productivity and revenue of a 7-hectare orchard over 30 years.

Year	Qty (kg)	kgs/plant	Sale Price/kg (R\$)*	Revenue (R\$)
0	-	-	-	-
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	3.33	0	13.91	46.36
5	10.00	0	13.91	139.08
6	21.48	0	13.91	298.71
7	843.18	1.2	13.91	11,727.25
8	1,619.55	2.3	13.91	22,525.18
9	2,752.27	3.9	13.91	38,279.53
10	8,724.55	12.5	13.91	121,343.89
11	6,777.27	9.7	13.91	94,260.57
12	15,805.68	22.6	13.91	219,830.69
13	3,935.91	5.6	13.91	54,741.94
14	17,500.00	25	13.91	243,395.83
15	14,875.00	21.3	13.91	206,886.46
16	17,500.00	25	13.91	243,395.83
17	14,875.00	21.3	13.91	206,886.46
18	17,500.00	25	13.91	243,395.83
19	14,875.00	21.3	13.91	206,886.46
20	17,500.00	25	13.91	243,395.83
21	14,875.00	21.3	13.91	206,886.46
22	17,500.00	25	13.91	243,395.83
23	14,875.00	21.3	13.91	206,886.46
24	17,500.00	25	13.91	243,395.83
25	14,875.00	21.3	13.91	206,886.46
26	17,500.00	25	13.91	243,395.83
27	14,875.00	21.3	13.91	206,886.46
28	17,500.00	25	13.91	243,395.83
29	14,875.00	21.3	13.91	206,886.46
30	17,500.00	25	13.91	243,395.83
Total Revenue				4,408,847.36

*Average price received by the producer in 2022.

implementation of pecan in legal forest reserve areas in the state of Santa Catarina, in an area of 1 ha with a density of 204 plants/ha and a MARR of 8% per year, over a period of 20 years, obtained an NPV of R\$ 168,306.43. The difference between the results of this study and those of the aforementioned studies is explained by the lack of investment accounting and the overestimation of pecan productivity. For FILIPPIN (2012), the average annual productivity of pecan from

the 14th to the 20th years reached 12,852 kg/ha. CAMARA et al. (2019) projected an average annual productivity of 5,012 kg/ha from the 14th year to the 30th year. GIROTTTO et al. (2016), when analyzing a 9.6-hectare orchard with 960 pecan trees in the state of Paraná and applying a MARR of 8.21% per year over a 15-year horizon, reported an NPV of R\$ 1,358,349.97. Conversely, CAMARA et al. (2019), FILIPPIN (2012), and GIROTTTO et al. (2016) did not account for capital

Table 4 - Demonstration and economic results of a 7-hectare orchard (in R\$) on a property in the state of Rio Grande do Sul from the years 0, 7th, 14th, 21st, 28th and 30th.

	-----Years-----					
	0	7	14	21	28	30
A - Revenue	-	11,727.25	243,395.83	206,886.46	243,395.83	243,395.83
-----B - Variable Costs-----						
Supplies	78,185.84	16,627.38	19,506.83	19,506.83	19,506.83	19,506.83
Manual Operations	11,132.62	14,104.55	48,242.39	44,304.89	48,242.39	48,242.39
Mechanized Operations	17,858.61	5,591.84	25,762.89	25,762.89	25,762.89	25,762.89
Operational Expenses	4,457.36	5,231.36	9,838.36	9,071.97	9,984.86	10,139.66
-----C - Fixed Costs-----						
Fixed Costs	16,446.07	17,296.07	17,296.07	17,296.07	17,296.07	17,296.07
Depreciation	-	8,689.80	15,981.66	9,478.08	1,442.83	1,442.83
D - Operational Cost (B + C)	128,080.50	67,541.01	136,628.22	125,420.74	122,235.88	122,390.68
E - Opportunity Cost (land)	11,426.31	11,426.31	11,426.31	11,426.31	11,426.31	11,426.31
F - Total Cost (D + E)	139,506.81	78,967.32	148,054.53	136,847.05	133,662.19	133,816.99
G - Result (A - F)	-139,506.81	-67,240.06	95,341.31	70,039.41	109,733.64	109,578.84
H - Producer's income (E + G + Manual Operations + Salary)	-102,403.88	-29,112.47	134,851.51	109,549.61	149,243.85	149,089.05
Total Cost R\$/ha	19,929.54	11,281.05	21,150.65	19,549.58	19,094.60	19,116.71
Total Cost/plant	199.30	112.81	211.51	195.50	190.95	191.17
Total Cost/kg	-	93.65	8.46	9.20	7.64	7.65

goods and overestimated productivity, projecting a productivity of 6,500 kg/ha in the 14th year.

In a recent study, CASAGRANDA et al. (2023), analyzing the production in six pecan

harvests, reported an average productivity of 2,490 kg/ha, reaching 4,185 kg/ha in the best harvest. The productivity estimated in the studies cited does not reflect the production of Brazilian pecan orchards.

Table 5 - Cash flow from pecan tree cultivation on 7 hectares on a property in the state of Rio Grande do Sul during the period from year 0 to year 5. Values in reais (R\$).

	-----Years-----					
Cash Flow	0	1	2	3	4	5
-----A - Inflows-----						
(+) Total Revenue	-	-	-	-	46.36	139.08
-----B - Outflows-----						
(-) Improvements	83,831.07	-	-	-	-	-
(-) Machines and equipment	112,800.00	23,350.42	-	-	-	150.00
(-) Supplies	78,185.84	7,269.51	2,190.00	2,191.67	23,218.40	6,997.35
(-) Manual operations	11,132.62	4,771.96	3,759.93	4,434.15	14,851.83	12,452.36
(-) Mechanized operations	17,858.61	3,232.89	1,657.89	1,657.89	1,657.89	3,868.42
(-) Operational expenses	4,457.36	4,460.99	3,843.49	4,144.29	4,567.19	4,960.08
(-) Fixed Costs	16,446.07	17,296.07	17,296.07	17,296.07	17,296.07	17,296.07
C - Net Cash Flow (A-B)	-324,711.57	-60,381.85	-28,747.38	-29,724.07	-61,545.02	-45,585.20
Accumulated Cash Flow	-324,711.57	-385,093.42	-413,840.80	-443,564.87	-505,109.89	-550,695.09
Discounted accumulated Cash Flow	-324,711.57	-380,776.43	-405,560.17	-429,353.83	-475,097.40	-506,556.43

Table 6 - Cash flow from pecan tree cultivation on 7 hectares on a property in the state of Rio Grande do Sul during the period from the 6th to 11th years. Values in reais (R\$).

	Years					
Cash Flow	6	7	8	9	10	11
-----A - Inflows-----						
(+) Total Revenue	298.71	11,727.25	22,525.18	38,279.53	121,343.89	94,260.57
-----B - Outflows-----						
(-) Improvements	-	-	-	-	-	-
(-) Machines and equipment	2,146.73	975.26	1,444.00	12,149.80	-	79,250.00
(-) Supplies	19,214.65	16,627.38	12,052.25	22,503.34	17,325.88	17,530.81
(-) Manual Operations	12,256.52	14,104.55	15,704.44	21,516.81	28,057.63	23,913.86
(-) Mechanized Operations	2,210.53	5,591.84	4,762.89	11,983.53	6,697.11	11,891.84
(-) Operational expenses	5,666.46	5,231.36	4,967.63	5,011.95	6,247.64	5,544.80
(-) Fixed Costs	17,296.07	17,296.07	17,296.07	17,296.07	17,296.07	17,296.07
C - Net Cash Flow (A-B)	-58,492.25	-48,099.21	-33,702.10	-52,181.97	45,719.55	-61,166.81
Accumulated Cash Flow	-609,187.33	-657,286.54	-690,988.65	-743,170.62	-697,451.06	-758,617.88
Discounted accumulated Cash Flow	-544,036.82	-572,654.07	-591,272.00	-618,037.74	-596,263.40	-623,311.90

Even with the expansion of pecan in Brazil, the low productivity of orchards (500 to 1,000 kg/ha), especially those established in recent decades, has become an impediment to increasing fruit production and quality (MARTINS et al., 2023b). CROSA et al. (2020) stated that the low productivity of several pecan orchards is directly associated with the fact

that they are in the juvenile phase, which means that they are unproductive and have not yet reached their maximum production peak. Another factor that differs substantially between the studies is that in the case of the model property in this study, its technology is considered at the medium/high level, which increases investments and costs but makes it possible to achieve

Table 7 - Demonstration and economic results of a 7-hectare orchard (in R\$) on a property in the state of Rio Grande do Sul from the 12th to the 17th years.

	Years					
Cash Flow	12	13	14	15	16	17
-----A - Inflows-----						
(+) Total Revenue	219,830.69	54,741.94	243,395.83	206,886.46	243,395.83	206,886.46
-----B - Outflows-----						
(-) Improvements	-	-	-	-	-	-
(-) Machines and equipment	9,500.00	-	-	-	-	-
(-) Supplies	21,999.87	17,564.92	19,506.83	21,165.13	19,506.83	19,506.83
(-) Manual Operations	44,348.71	26,633.71	48,242.39	44,304.89	48,242.39	44,304.89
(-) Mechanized Operations	26,812.89	26,812.89	25,762.89	26,868.16	25,762.89	25,762.89
(-) Operational expenses	10,157.48	7,078.12	9,838.36	10,505.07	9,984.86	9,291.47
(-) Fixed Costs	17,296.07	17,296.07	17,296.07	17,296.07	17,296.07	17,296.07
C - Net Cash Flow (A-B)	89,715.67	-40,643.78	122,749.28	86,747.13	122,602.78	90,724.30
Accumulated Cash Flow	-668,902.21	-709,545.99	-586,796.71	-500,049.57	-377,446.79	-286,722.50
Discounted accumulated Cash Flow	-586,475.27	-601,970.21	-558,519.28	-530,007.81	-492,592.52	-466,885.21

Table 8 - Demonstration and economic results of a 7-hectare orchard (in R\$) on a property in the state of Rio Grande do Sul from the 18th to the 23rd years.

Cash Flow	Years					
	18	19	20	21	22	23
-----A - Inflows-----						
(+) Total Revenue	243,395.83	206,886.46	243,395.83	206,886.46	243,395.83	206,886.46
-----B - Outflows-----						
(-) Improvements	-	-	-	-	-	-
(-) Machines and equipment	-	-	-	-	-	-
(-) Supplies	19,506.83	19,506.83	21,165.13	19,506.83	19,506.83	19,506.83
(-) Manual Operations	48,242.39	44,304.89	48,242.39	44,304.89	48,242.39	44,304.89
(-) Mechanized Operations	25,762.89	25,762.89	26,868.16	25,762.89	25,762.89	25,762.89
(-) Operational expenses	10,188.06	10,038.07	11,573.71	9,071.97	10,996.46	9,153.97
(-) Fixed Costs	17,296.07	17,296.07	17,296.07	17,296.07	17,296.07	17,296.07
C - Net Cash Flow (A-B)	122,399.58	89,977.70	118,250.37	90,943.80	121,591.18	90,861.80
Accumulated cash flow	-164,322.91	-74,345.22	43,905.15	134,848.95	256,440.13	347,301.93
Discounted accumulated Cash Flow	-434,682.14	-412,701.69	-385,879.86	-366,726.58	-342,949.60	-326,452.02

productivity and quality similar to that recommended by the research organizations and published in MARTINS et al. (2023b) and CASAGRANDA et al. (2023), among others.

The results of this study demonstrated that the implementation of the orchard in the established scenario is considered economically unfeasible, as the project will not pay according to the minimum expected amount. However, it was shown that culture generated income for the producer. Therefore, two scenarios were simulated to establish the enterprise's break-even point, equating total revenues to total costs. In the first scenario, average productivity increased, and in the second scenario, the sales price increased. Due to being a long-cycle culture with very different economic results from one year to the next, as a result of productive alternation, to calculate the break-even point, NPV was used as the analysis variable and not the profit. In other words, the break-even point is the one at which the NPV equals zero. With an increase of 23.62% in average productivity or an increase of 21.51% in sales price, the analyzed undertaking will reach the break-even point in the analyzed time horizon. In this context, an alternative to mitigate the impact of the lack of income in the initial years of production and disbursements for investments and technology is the intercropping of pecan with other crops. Intercropping can have advantages such as reducing

production costs, diluting investment costs and fixed costs, generating extra revenue for the property, reducing risks associated with depending on the income from a single crop, and providing a better use of soil and existing resources on properties.

CONCLUSION

The results of this study, which analyzed the economic viability of pecan production on a representative rural property in Rio Grande do Sul, demonstrated that the average total cost per hectare in the years analyzed was R\$ 18,353.69. Regarding economic viability, a negative NPV was obtained, showing that the project will not pay in accordance with the minimum expected. Nevertheless, it is concluded that the enterprise generated an average annual income of R\$ 68,536.28 for the producer and that with an increase of 23.62% in average productivity or an increase of 21.51% in the sales price, the enterprise analyzed reached the break-even point in the analyzed period. It is noteworthy that due to the adverse macroeconomic situation, which strongly impacts the costs of establishing and maintaining orchards, new studies must be carried out considering the cultivation of pecan trees at a commercial level in conjunction with other activities, as well as considering the use of financing. In addition, future research should develop simulation

Table 9 - Demonstration and economic results of a 7-hectare orchard (in R\$) on a property in the state of Rio Grande do Sul from the 24th to the 30th years.

	Years						
Cash Flow	24	25	26	27	28	29	30
-----A - Inflows-----							
(+) Total Revenue	243,395.83	206,886.46	243,395.83	206,886.46	243,395.83	206,886.46	243,395.83
-----B - Outflows-----							
(-) Improvements	-	-	-	-	-	-	-
(-) Machines and equipment	-	-	-	-	-	-	-
(-) Supplies	19,506.83	21,165.13	19,506.83	19,506.83	19,506.83	19,506.83	19,506.83
(-) Manual Operations	48,242.39	44,304.89	48,242.39	44,304.89	48,242.39	44,304.89	48,242.39
(-) Mechanized Operations	25,762.89	26,868.16	25,762.89	25,762.89	25,762.89	25,762.89	25,762.89
(-) Operational expenses	10,094.36	9,504.67	10,356.96	10,970.93	9,984.86	9,327.97	10,139.66
(-) Fixed Costs	17,296.07	17,296.07	17,296.07	17,296.07	17,296.07	17,296.07	17,296.07
C - Net Cash Flow (A-B)	122,493.28	87,747.53	122,230.68	89,044.84	122,602.78	90,687.80	122,447.98
Accumulated Cash Flow	469,795.21	557,542.74	679,773.42	768,818.26	891,421.04	982,108.84	1,104,556.82
Discounted accumulated Cash Flow	-305,801.30	-292,065.86	-274,300.59	-262,283.90	-246,921.44	-236,370.45	-223,142.86

scenarios that consider cost reduction since this variable can impact the results obtained. Finally, it is recommended that properties of different sizes be analyzed so that scenarios can be evaluated at different production scales.

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DECLARATION OF CONFLICT OF INTEREST

We have no conflicts of interest to declare.

AUTHORS' CONTRIBUTIONS

All authors contributed equally to the conception and writing of the manuscript. All authors critically reviewed the manuscript and approved the final version.

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