Article

Financial evaluation with methodology of real investment options for production and sale of organic coffee

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Abstract

In Mexico, coffee farming is a highly relevant activity due to the generation of foreign exchange, jobs and the ecological importance of the crop; however, due to the uncertainty that the price provides, in the last 10 years the production of cherry coffee decreased at an average annual rate of 6%. An alternative to face this crisis is to differentiate the product and produce organic coffee. The present investigation was carried out in 2018 in the municipality of Ixhuatlan, Veracruz. The profitability of the production and sale of organic coffee was calculated through the evaluation of traditional financial investment projects for producers and cooperative (NPV= 1 504 372 and 283 566 respectively), complemented with the real options methodology; through binomial trees, which contemplates the volatility of prices and the change in decisions that the manager can make throughout the project. The analysis of the results showed that there are greater benefits when considering the expansion-abandonment option through the calculation of the total NPV of the production and sale of organic coffee with the real options methodology (1 959 111 and 411 455, respectively).

Keywords: abandonment, expansion, organic coffee, profitability, real options, volatility.

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Introduction

The coffee production chain constitutes one of the most important items within the agroindustrial sector in Mexico due to the social and environmental impact it generates, coupled with the economic impact that this entails in almost the entire world (López and Caamal, 2009). In Mexico there are 15 producing states, Veracruz is the second producing state that contributes 24% of the national volume. Currently, coffee represents 0.66% of the national agricultural gross domestic product (GDP) and 1.34% of the production of agro-industrial goods (SADER, 2018).

Mexico has the necessary conditions for coffee growing with areas that are at altitudes higher than 900 meters above sea level, also with temperatures ranging from 17.5 to 27.3 °C. This activity for the country is of great environmental relevance, since 99% of the properties are under shade (FIRA, 2016).

Mexico is the 11th largest coffee producer in the world (SADER, 2018). For the 2015-2016 cycle, Mexico was in the twelfth position with 1.5% of world exports, of which approximately 94.5% of production is obtained from the Arabica species and 5.5% corresponds to a robust variety (FIRA, 2016). Coffee year 2018-2019 is estimated to be the second consecutive year of surplus, given that world production, which, according to calculations, will be 167.47 million bags, will surpass world consumption, which, according to calculations, will be 165.18 million sacks (ICO, 2019).

In the context of markets, SADER (2018) indicates that, of the total Mexican coffee exports, 53.85% go to the United States of America, the remaining volume to member countries of the European Union bloc, Japan, Cuba and Canada, mainly.

Coffee consumption in Mexico grew at an average annual rate of 2% between 2005-2006 and 2015-2016, standing at 2.35 million 60-kg bags, in the equivalent volume of green coffee; 64.9% of consumption corresponded to its form in soluble coffee and 35.1% as roasted and ground coffee (FIRA, 2016). The average annual growth rate (TMAC) of coffee consumption in Mexico in the last decade was 2.4% (ASERCA, 2017). SADER (2018) indicates that currently 1.4 kg are consumed per capita per year.

Coffee farming in Mexico stands out not only for its social and economic relevance, but also for its current and potential contribution to the conservation of important areas with vegetation, providing important environmental services, such as: soil erosion control, water collection, maintenance of biodiversity and carbon capture, among others (Fomento Economico de Chiapas, 2005). Gordon *et al*. (2007), found that the high diversity of animal and plant species in regions where coffee is grown is compatible with high profits and has significant potential for the conservation of biodiversity in regions where coffee is produced.

In the last decade, the interest in using non-destructive and clean forms of coffee production has been stimulated from industrial countries by the pressure of a new sector of consumers with ecological and social conscience, generating alternative marketing networks that offer better prices and purchase conditions than the conventional market (Moguel and Toledo 2004).

Organic coffee is obtained from crops that are governed under traditional techniques and where no pesticides or synthetic fertilizers have been used, the coffee trees are fertilized with organic materials prepared by composting (SAGARPA, 2016). ‘Currently Mexico allocates an area of 30 thousand hectares for the production of organic coffee, located in the states of Chiapas and Oaxaca, mainly and as an exporting leader it sends more than 28 thousand tons each year to Europe, which is commercialized, generally , in health food stores in the main cities of the Old Continent’ (SAGARPA, 2016).

Coffee cultivation is distinguished as a strategic activity in Mexico and by integrating into production chains it generates foreign exchange and jobs that allow the subsistence of many small producers (Tomas *et al*., 2018) ‘however, despite its relevance, the coffee sector has been immersed in recurrent crises due to the fall in prices in the international market’ (Escamilla *et al*., 2015), in addition to the continuous changes in the coffee trade, problems in the competitive environment, diseases and crop pests (SADER, 2018).

To cope with these problems, some producers choose as a strategy to change their conventional to organic crops in order to improve their profitability levels (Perea, 2010). ‘The linkage of organic agriculture with the poorest sectors of the rural population makes it an alternative of economic development for the rural communities of the state’ (Cadeza *et al*., 2017). ‘The profitability of the organic coffee producer is higher than that of the conventional producer, which implies higher profits’ (Barrita *et al*., 2018).

Due to the uncertainty towards the production of organic cultivation (climatic variability) and the practices that this requires, the organic products market offers a price premium; however, there is a guarantee to consumers about production methods through a certification process (ICO, 2019).

According to Copeland and Antikarov (2001); Brach (2003); Brambila (2011) cited by Cadeza *et al*. (2017) mention that to make a financial evaluation of a project that participates in a volatile market, it is no longer enough to use traditional methodologies such as net present value (NPV), cost benefit (B/C) and the internal rate of return (IRR), but the real options methodology must also be used. These financial indicators are not capable of dealing with the lack of past data, the uncertainty, the reversibility of investment in innovation (Brasil *et al*., 2018).

Cadeza *et al*. (2017) mention that a real option is a financial evaluation methodology, which considers that the management of a project makes decisions throughout its useful life to adapt to the changing circumstances of the market and technology. Management may decide in due course to expand, reduce, abandon, continue, stop being monovalent and become versatile; likewise, it can decide to postpone, wait to know what is happening in the market or invest in land for planting and expand production.

The objective of this work was to calculate the profitability of the production and sale of organic coffee, for the producers and cooperative of Ixhuatlan, Veracruz, using the methodology used to evaluate traditional financial investment projects, in addition to this, the analysis was complemented with the real options methodology that contemplates the volatility of prices and the change of decisions that can be made by the person in charge of the project.

The hypothesis of the work was that despite the volatility of coffee prices, organic production is more profitable when it expands at least 35% of its installed capacity, or is considered the abandonment option, for both projects.

Materials and methods

The study was carried out in the municipality of Ixhuatlán del Cafe in the state of Veracruz. The municipality is located between parallels 18° 57’ and 19° 06’ north latitude; the meridians 96° 50’ and 97° 01’ west longitude, altitude between 800 and 1 900 m. It borders to the north with the municipality of Coscomatepec, Huatusco and Tepatlaxco; to the east with the municipalities of Tepatlaxco and Atoyac, to the south with the municipalities of Atoyac, Amatlán de los Reyes and Córdoba, to the west with the municipalities of Cordoba, Tomatlan and Coscomatepec (INEGI, 2019).

The transformation process from cherry coffee to ground coffee is constituted by a series of stages that are described in Figure 1 and that need to be known for the evaluation of a financial investment project.

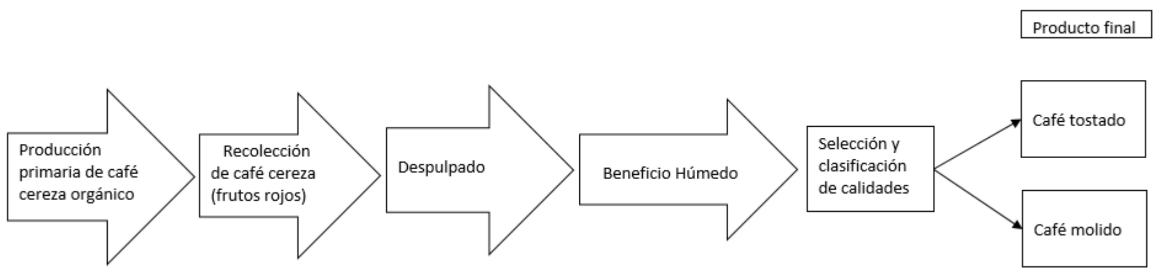

Figure 1. Coffee transformation process. Elaboration with information from the Cooperativa Campesinos en la Lucha Agraria, SC of RL of CV.

The process of obtaining organic coffee takes 3-4 years from when agrochemicals were no longer used in the cultivation and an organic cultivation management plan is implemented, scheduled and with the specific activities to be carried out on the plant coffee, the soil and its ecosystem. Certification is through third-party certification agencies that guarantee compliance with the standards (Delgado and Pérez, 2013).

Financial information on the production and sale of coffee was collected through surveys directed at organic coffee producers and the Cooperativa Campesinos en la Lucha Agraria, SC of RL of CV in the municipality of Ixhuatlan del Cafe, Veracruz during 2018. The main income for the producers were calculated by multiplying the yield of coffee by its sale price ($55.00 MN) and adding the income from other activities (handicrafts, seedlings and fertilizer of coffee, other fruit trees and anthuriums).

In the case of the cooperative, the income was obtained from the sale of the coffee produced by the producers for the sale price to the consumer ($125.00 MN), adding to these other activities (crafts and local ecotourism). Also, the fixed, variable costs and operating expenses directly related to the production and sale of coffee were calculated.

In the case of producers, the questionnaire included general data on the producer and crop, seedling management, use of natural insecticides, fertilizers, biological herbicides, manual, mechanized labor, crop yield, various materials used in coffee production, administration and services for organic coffee; as well as income per year from other crops and activities previously mentioned. Other data captured was related to the commercialization process and sources of financing.

The cooperative was asked about aspects related to the type of organization, seals, certification, technical assistance, performance acquired by the producers, sale price to the consumer, income per year of coffee and other activities, sources of financing, benefits and programs of the government. In this way, the cooperative acquired cherry, parchment green, roasted and ground coffee from the producers for its final processing and packaging.

For data collection, simple random sampling was used. In this case, each and every individual in the population has the same and independent probability of being selected as a member of the sample (Santoyo *et al*., 2002). The sample size was estimated based on the 156 producers who are members of the Vida, AC association. An accuracy of 5%, a reliability of 95% and a coefficient of variation of 20% were considered. $n=\frac{NZ^2CV^2}{(N-1)*d^2+Z^2CV^2}$ 1)

Where: N= population size (156 producers); d= precision (0.05); Z= level of reliability (value of the Z distribution (1.96)); CV= coefficient of variation of the variable on which precision and reliability are established (0.20). The traditional financial evaluation of a project to estimate its net present value (NPV) consists of estimating the benefits and costs in each period and obtaining a cash flow that is updated to the start period using a discount rate. If the value of the NPV is positive, it is recommended to invest in the project (Cadeza *et al.*, 2017).

The data to calculate the NPV were obtained based on financial information on the production and sale of organic coffee by the producers and the Cooperativa Campesinos en Lucha Agraria, SC of RL of CV. SC: civil society, RL: limited liability, CV: variable capital.

From the municipality of Ixhuatlan del Cafe, Veracruz, a useful life of the project of 10 years and a TREMA were considered: minimum acceptable rate of return, calculated from the real interest rate of CETES + 3 profit points, obtained in the month October 2018, 10.65% (Table 1).

According to Baca (2013), the NPV ‘is the monetary value that results from subtracting the sum of the discounted flows from the initial investment’. $VAN= -I+\sum_{i=1}^{t}\frac{b_i-c_i}{(1+\partial)^t}$ 2)

Where: I= initial investment; b_i = benefit at time i; c_i= cost at time i; ∂= discount rate, t= time or investment horizon.

Another financial variable to evaluate investment projects that was calculated in this research is the benefit-cost ratio, based on formula 3 by Domínguez (2011) cited by Valencia *et al*. (2010).

$$\frac{B}{C}= \sum_{t=1}^{n} Bt(1+r)^{-1} / \sum_{t=1}^{n} Ct(1+r)^{-1} \qquad 3)$$

Where: t= years of project life; B= updated profits resulting from multiplying the price by the quantity sold; r= interest rate; C= updated production costs. This is the relationship obtained when the present value of the profit stream is divided by the present value of the cost stream (Gittinger, 1982). The ratio indicates that for each peso invested there will be benefits when this ratio is greater than one.

Table 1. Breakdown of income and costs of organic coffee production.

Period	0	1	2	3	4	5	6	7	8	9	10
						Producers					
Total production (kg)		7 485	7 485	16 634	16 634	16 634	16 634	16 634	15 803	14 971	14 139
Rural average price ($ kg^{-1})		55	55	55	55	55	55	55	55	55	55
Land residual value											2 530 000
Recovery of working capital											613 033
Subsidy†		2 500	2 500	2 500	2 500	2 500	2 500	2 500	2 500	2 500	2 500
Coffee by-product income		238 055	238 055	529 011	529 011	529 011	529 011	529 011	502 561	476 110	449 659
Variable costs	0	321 499	321 499	714 441	714 441	714 441	714 441	714 441	678 719	642 997	607 275
Fixed costs	137 983	8 773	8 726	8 680	8 633	8 587	8 540	8 540	8 540	8 540	8 540
Investments††	2 581 000										
Incremental working capital		290 195		353 648					32 150	32 150	32 150
						Cooperative					
Subsidy§	87 760										
Production acquired from producers (kg)		3 755	3 943	4 140	4 347	4 564	4 793	5 032	5 284	5 548	5 825
Sale price ($ kg^{-1})		125	125	125	125	125	125	125	125	125	125
Income from coffee by-products		80 000	80 000	80 000	80 000	80 000	80 000	80 000	80 000	80 000	80 000
Ecotourism		43 650	43 650	43 650	43 650	43 650	43 650	43 650	43 650	43 650	43 650
Variable costs		389 263	408 726	429 162	450 620	473 151	496 809	521 649	547 731	575 118	603 874
Fixed costs		2 388	2 388	2 388	2 388	2 388	2 388	2 388	2 388	2 388	2 388
Investments§§	176 177										
Incremental working capital		352 485	17 517	18 393	19 312	20 278	21 292	22 356	23 474	24 648	25 880
ISR§§§		57 298	58 475	59 712	61 010	62 373	63 805	65 308	66 886	68 543	70 283
Utilities‡		19 099	19 492	19 904	20 337	20 791	21 268	21769	22 295	22 848	23 428

†= from the cooperative to the producers for the acquisition of plants; ††= soil, mower and pulper; §= for acquisition of organic certificate from the state government; §§= pulper, sieve and a demucilager; §§§= income Tax of 30%; ‡= worker participation in profits of 10%.

The statistical series of nominal prices for organic coffee were obtained from the Agri-Food and Fisheries Information Service (SIAP, 2018) and were deflated with the national producer price index (IPP) based on 2017 (INEGI, 2019), using formula 4 used by Brambila (2011).

$$PR_t = \frac{P_t}{1+\pi} \qquad 4)$$

Where: P_t= nominal price at time t; π = inflation rate; PR_t = real price at time t. For the evaluation with the real option of expanding and abandonment, the methodology used by Copeland and Antikarov (2001) was used; Brach (2003); Brambila (2011), who point out that the real options are the right but not the obligation to exercise an action during the useful life of the project.

In this work, the evaluation with real options was carried out through binomial trees with the option of expanding 35% of the installed capacity and with the option of abandonment, according to the following steps:

Step one: Obtain the continuous movement rates of the real prices of organic coffee with formula 5 (Cadeza *et al*., 2017). $r_t = \ln\left(\frac{P_{t+1}}{P_t}\right)$ 5)

Where: r= continuous movement rate of real prices; ln= natural logarithm; P_t = real price in year t; P_{t+1}= real price in year t+1 Step two: calculate the variance of the continuous rates. To add the volatility of organic coffee prices, the standard deviation of continuous movement rates was calculated, which is the average volatility of prices with formula (6).

$$\sqrt{\sigma^2} = \sqrt{\frac{\sum_{i=1}^{T}(r_t - \bar{x})^2}{t-1}} = \sigma \qquad 6)$$

Where: σ= standard deviation of the continuous rates of real prices, t= total of the periods; $\bar{x}$ = average of continuous rates of change. Step three: calculation of the probability of occurrence of the project. With equation (6), two values were obtained, one on the upside ($u= e^{\sigma}$) and the other on the downside ($d^{-\sigma}$). Where: u is what increases the value of the project due to an increase in prices, d is what decreases the value of the project due to a decrease in prices and *e* is the Euler number (Cadeza *et al*., 2017). According to Brach (2003) cited by Brambila *et al*. (2013), the value of the project can increase or decrease and the probability of this happening is shown in formula 7 and 8.

$$p = \frac{(1+l)-d}{u-d} \qquad 7) \qquad 1-p = \text{probability that the project will decrease} \qquad 8)$$

Where: p= probability of increasing the value of the project; l= risk-free interest rate; u= what increases the value of the project and d= what lowers the value of the project. Step four: form the binomial tree. Once you have the nodes and a horizon for organic coffee, a binomial tree is formed with the real option of expanding the installed capacity and another with an expansion-abandonment option, for the producers and for the cooperative. For this, the values in the nodes of the last year were calculated at present value, until reaching the value of the real option of expansion and expansion-abandonment, (Brach, 2003; Brambila *et al*., 2013; Cadeza *et al*. 2017), the calculation was made with formula 9.

$$V_{QC}=\frac{p\ (Vu)+(1-p)Vd}{1+l} \quad 9)$$

Where: V_{QC}= net present value in the current period; p= probability of increasing the value of the project; 1-p= probability that the value of the project will decrease; l= risk-free interest rate; Vu= net present value of the project value increasing a previous period; Vd= net present value of a decrease in the value of the project from a previous period.

The binomial tree is formed from the NPV of the producers and cooperative project, obtained from the financial evaluation of investment projects, adding the values of u and d to the subperiods. The binomial tree starts at the present value of the cash flow, multiplying the previous value by u and d successively until reaching the last year (Figure 2).

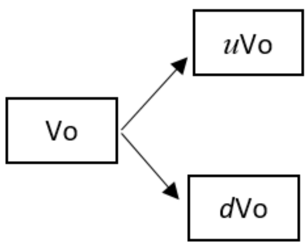

Figure 2. Binomial tree. Díaz and Hernández (2003).

Where: Vo= present value of the stock or discounted cash flow; *u*Vo= value that 'we are doing well'; *d*Vo= value that 'we are doing wrong'. Step Five: Finally Compare Total Project NPV with and without actual option. Mascareñas *et al*. (2004); Brambila *et al*. (2013) cited by Cadeza *et al*. (2017) indicate that the current value of the total net value of the project will be equal to the traditional net present value plus the value of the real option as shown in formula 10, that is, the value of being able to choose expansion, expansion-abandonment of the production and sale of organic coffee. NPV_{Total}= NPV+OR(10).

Where: NPV_{Total} = total net present value; NPV= net present value calculated in the traditional way; OR= real option. The NPV of both projects was calculated, that is, the NPV of the producers and the NPV of the cooperative, building binomial trees for both projects with the option of expanding the installed capacity by 35% and with the option expansion-abandonment.

Results and discussion

The results of the present investigation are presented below. To determine the financial variables, the benefits and costs of the project of the coffee producers and the cooperative, they were updated at a rate of 10.65% on an annualized basis (Table 2). In this way, for both projects the NPV and the B/C ratio were positive, so according to the criteria of Gittinger (1982) both projects are accepted. On the other hand, the IRR was higher than the TREMA, this suggests that, if considered as an investment portfolio, these projects are financially acceptable.

Table 2. Updated benefits, costs and flow of funds from the production and sale of coffee.

Year	Project benefits ($)		Project costs ($)		Updated cash flow ($)	
	Producers	Cooperative	Producers	Cooperative	Producers	Cooperative
0	0	87 760	2 718 983	176 177	-2 718 983	-88 417
1	653 888	591 419	620 466	820 532	30 205	-207 061
2	653 888	614 807	330 225	506 597	264 357	88 382
3	1 450 030	639 365	1 076 769	529 558	275 523	81 054
4	1 450 030	665 151	723 074	553 667	484 956	74 372
5	1 450 030	692 226	723 028	578 981	438 307	68 275
6	1 450 030	720 655	722 981	605 561	396 145	62 711
7	1 450 030	750 505	722 981	633 470	358 017	57 631
8	1 377 653	781 848	655 109	662 774	321 553	52 991
9	1 305 277	814 758	619 387	693 544	275 862	48 752
10	4 375 934	849 313	583 665	725 852	1 378 430	44 876
NPV					1 504 372	283 566
IRR					18.21%	29.53%
B/C					1.22	1.07

However, the income obtained (NPV) in the investment project of the producers is 5.3 times higher than that of the cooperative, which indicates that if it were decided to look for the best alternative (opportunity cost), it would be necessary to consider investment in the cooperative because the IRR 'represents the maximum interest rate that a project can pay for the resources used if it wants the project to recover its investment and operating expenses' (Gittinger, 1982; López and Caamal, 2009).

They claim that producing organic coffee can reduce production costs by eliminating the expense of industrial fertilizer and thus guarantee that incomes are above costs, even though 'the costs of organic coffee are higher than those of conventional coffee, the cultivation of the former is more profitable'. Caleb *et al*. (2006) found that in shadow and organic coffee production systems they generate simultaneous increases in biodiversity and profitability of coffee agroecosystems.

Once the NPV have been obtained in the traditional way for both projects, the calculation is carried out with real options, these values are presented from year 1 onwards, which consider the volatility of the prices of organic coffee, and what the projects would be worth for the producers and cooperative when they rise or fall in value over a 10-year horizon. The results of real options for other types of projects are confirmed with those presented by Cadeza *et al*. (2017); Fenichel *et al*. 2008; Tamara *et al*. 2012; Vedovoto *et al*. 2015 (cited by Cadeza *et al*., 2017), in relation to the fact that the income during the calculation horizon is higher than the costs, even considering that the difference between them is not very wide, as can be seen in year 10 (Table 3).

Table 3. Dynamics of the value of the project of production and sale of organic coffee of the project of the producers and the cooperative (thousands of pesos).

Values ($ year^{-1})	0	1	2	3	4	5	6	7	8	9	10
	1 50 372	1 763 214	2 066 592	2 422 169	2 838 927	3 327 391	3 899 901	4 570 917	5 357 388	6 279 178	7 359 572
		1 283 528	1 504 372	1 763 214	2 066 592	2 422 169	2 838 927	3 327 391	3 899 901	4 570 917	5 357 388
			1 095 105	1 283 528	1 504 372	1 763 214	2 066 592	2 422 169	2 838 927	3 327 391	3 899 901
				934 342	1 095 105	1 283 528	1 504 372	1 763 214	2 066 592	2 422 169	2 838 927
					797 180	934 342	1 095 105	1 283 528	1 504 372	1 763 214	2 066 592
						680 153	797 180	934 342	1 095 105	1 283 528	1 504 372
							580 306	680 153	797 180	934 342	1 095 105
								495 116	580 306	680 153	797 180
									422 433	495 116	580 306
										360 419	422 433
											307 509
	283 566	332 356	389 541	456 566	535 122	627 195	735 110	861 593	1 009 839	1 183 591	1 387 240
		241 938	283 566	332 356	389 541	456 566	535 122	627 195	735 110	861 593	1 009 839
			206 421	241 938	283 566	332 356	389 541	456 566	535 122	627 195	735 110
				176 118	206 421	241 938	283 566	332 356	389 541	456 566	535 122
					150 264	176 118	206 421	241 938	283 566	332 356	389 541
						128 205	150 264	176 118	206 421	241 938	283 566
							109 384	128 205	150 264	176118	206 421
								93327	109 384	128 205	150 264
									79 626	93 327	109 384
										67 937	79 626
											57 964

The profitability indicators are σ= 0.16, u= 1.17, d= 0.85, p= 0.69.1-p= 0.31. Elaboration with data from SIAP (2018).

The expansion option shows a scenario in which it is profitable to invest for the expansion of 35% in the installed capacity of the producers and of the cooperative (suggestion of the association). The results of the evaluation by Delgado and Pérez (2013) of the conversion of conventional coffee to organic coffee carried out in Huatusco, Veracruz, showed that it is profitable to invest in organic coffee coming from a situation in which conventional coffee was already grown; likewise, they mention that the real options methodology allows to model the decision to abandon the project and continue with a better alternative. In this way, the NPV_{Total}, obtained from the real options methodology, shows a greater benefit for both investment projects, which makes them profitable, Table 4.

Table 4. Comparison of project earnings with the 35% expansion option.

Project	NPV ($)	OR ($)	NPV_{Total} ($)
Producers	1 504 372	452 880	1 957 252
Cooperative	283 566	47 324	330 890

NPV= net present value; OR= real option; NPV_{Total}= NPV+ OR. Elaboration with data from Tables 2 and 3.

In the Table 5 shows the results of the combination of the expansion and abandonment option for both projects. For the producers, the possibility of selling the project for a value that represents a loss or profit at the same time ($885 500), which is the value of the land) was simulated. Based on the trees with the expansion option, we proceeded to substitute the values that were below the amount established for the sale of the project. For the cooperative project, the average value of the binomial tree with expansion ($416 442) was considered, the same procedure as the previous one was performed to obtain the simulated real option.

Table 5. Comparison of earnings per project with the expansion-abandonment option.

Project	NPV ($)	OR ($)	NPV_{Total} ($)
Producers	1 504 372	454 739	1 959 111
Cooperative	283 566	88 465	411 455

NPV= net present value; OR= real option; NPV_{Total} = NPV + OR. Elaboration with data from Tables 3 and 4.

By complementing a project considering the real options, the value of the project will increase, which coincides with Valencia *et al*. (2010) who; through the Black-Scholes formula, they considered an expansion option of 6 ha of the production of differentiated nopal, of the project, obtaining as a result a modest increase year by year. Cadeza *et al*. (2017) states that when considering the real option to invest in the second year, the NPV tends to increase by more than 50%. Finally, in both projects the real option of expansion-abandonment increases its net present value, thus improving the investment alternative.

Conclusions

In the organic coffee production chain, value is added by improving profits, due to the price premium paid compared to conventional coffee (organic price $8.41 and conventional price $6.41 pesos MN 00/100), making it an alternative to increase producers' incomes and living conditions and to face the unstable international prices, as well as to contribute to the conservation of vegetated areas.

When evaluating the projects in a traditional way, during the useful life of both at an update rate of 10.65%, the cooperative's project obtained an NPV of $283 566 and the producers of $1 504 372, making them financially profitable. However, the cooperative project obtained a higher IRR, which implies that the interest rate that a project can pay with the resources invested in year zero, would be recovered from the second year.

By evaluating the projects in a traditional way and complementing them with the real option of expansion-abandonment; through binomial trees, it is observed that the total net present value increases, this option has a higher value than without considering this methodology, so it is convenient to expand the installed capacity of the projects and consider the possibility of abandoning the project at a time when product prices decrease or production-related input costs increase.

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