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REAL OPTIONS AND PRODUCTIVE RECONVERSION BY LOW-INCOME PRODUCERS: THE CASE OF HIBISCUS IN GUERRERO, MEXICO

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ABSTRACT

The growing demand for value-added agrifood products, combined with a changing economic environment and greater uncertainty, requires the application of flexible valuation methods that reflect the real value of an asset in the face of changes in investment. The objective of this study is to determine the impact of hibiscus (*Hibiscus sabdariffa* L.) price volatility on the decision to carry out a productive reconversion by low-income farmers who conventionally grow hibiscus in association with maize. It is stated that the producer will have greater incentives and will opt for a productive reconversion as the volatility of conventional hibiscus prices increases. This study was conducted in the state of Guerrero, Mexico, in 2020. Information on prices, yields, production, and harvesting costs was obtained from databases and interviews with producers. The interviews were conducted using the focus group method, while the binomial method was used to apply the option theory. The results revealed that the productive reconversion was profitable in no less than seven years. Additionally, a variation in volatility from 0.15 to 0.30 increased the likelihood of conventional hibiscus producers facing low prices by 27 to 44 %, improving the incentive to adopt a higher-quality production system. Therefore, it is confirmed that the real options theory is sufficiently flexible to model the impact of price volatility on producer investment decisions, in addition to providing a better understanding of low-income producers' decisions to implement a productive reconversion system.

Keywords: *Hibiscus sabdariffa* L., binomial method, real option, volatility.

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INTRODUCTION

The growing demand for value-added agrifood products, combined with a changing economic environment and greater uncertainty, requires the application of flexible valuation methods that reflect the real value of an asset in the face of changes in investment (García-Ramos *et al*., 2016). The traditional Net Present Value (VPN) has been widely used in the agricultural sector to analyze investment decisions; however, this method limits the modeling of the impact that prices have during the course of the investment (Arya *et al.*, 1998). On the contrary, the real options method introduced by Myers (1977) has been considered the most appropriate to capture the intrinsic flexibility of projects in response to unexpected market movements and, in turn, to propose different business strategies (Venegas-Martínez and Fundia-Aizenstat, 2006). Most studies on the real options method applied to the agrifood sector in Mexico, despite highlighting the flexibility of this method to respond to the feasibility of investing in a higher value-added product, leave unexplained how product prices influence the investment decisions of economic agents (Ortiz-Rivera *et al*., 2020; Valencia-Sandoval and Zetina-Espinosa, 2016). Ihli *et al.* (2018) have pointed out that the risk associated with fluctuations in the price of a good has an impact on the economic decisions of the producer, particularly if the producer has a low income. Valencia-Sandoval *et al.* (2010) found that price volatility is a critical factor in the investment of an agricultural good, so that the higher the volatility, the higher the risk and the lower the incentives to invest under a conventional production system. Alternatively, Asibey *et al.* (2019) note that producers cope with price fluctuations in their product by adding value in a way that allows for product differentiation.

The objective of this research is to determine the impact of hibiscus flower price volatility on the decision to carry out a productive reconversion by low-income producers who conventionally grow hibiscus in association with maize in the state of Guerrero. Hibiscus (*Hibiscus sabdariffa* L.) is a plant species whose calyx is mainly exploited for food and pharmaceutical use (Ariza-Flores, 2014). In 2020, apparent national consumption in Mexico was 17 209 Mg, which included national production of 8249 Mg (SIAP, 2021), imports of 9075 Mg, and exports of 115 Mg (SIAVI, 2021).

At the national level, Guerrero is the main production area, accounting for 74 % with 15 750 ha (SIAP, 2022). In that state, the cultivation of hibiscus in association with maize has social relevance since at least 6000 low-income producers cultivate it annually on rainfed land ranging from 1 to 3 ha, with low fertility and little technology, achieving yields between 250 and 300 kg ha^{-1}, one of the lowest at the national level (SIAP, 2022). Producers allocate minimal resources for the purchase of inputs, which, in the case of application, are agrochemical herbicides and fertilizers. Additionally, activities related to production and harvesting are carried out by family labor, which generates employment but does not meet quality standards in terms of product handling (Ariza-Flores *et al*., 2014).

Despite the social relevance of the associated production of both crops, they serve different purposes. While hibiscus is destined for commercialization, the price of this product is relevant for the producer; maize, on the other hand, is destined for family consumption and, to a lesser extent, for planting the following production cycle and commercialization (surplus) (Ariza-Flores *et al*., 2014). Focusing on the hibiscus crop, the price of the calyx presented a historical annual volatility of 15.21 % from 2015 to 2021, which is lower than that of other agricultural commodities (Valencia-Sandoval *et al*., 2010; Delgado-Juárez and Pérez-Akaki, 2013; Valencia-Sandoval and Zetina-Espinosa, 2016; Ortiz-Rivera *et al*., 2020). Still, the question arises as to how price volatility might impact the decisions of low-income producers who conventionally grow hibiscus in association with maize.

In the present analysis, the productive reconversion decision is carried out by a low-income producer who cultivates on average one hectare of hibiscus in association with maize (Ariza-Flores *et al*., 2014). The producer initially implements a conventional production system. If the producer opts for conversion, they make an additional investment and incorporate good agricultural practices (BPA) and harvesting practices that allow them to obtain a safe product while receiving a better price under the same crop association. Based on the above, the following hypothesis is proposed: as the price volatility of the conventional production system increases, the producer will have more incentives to opt for a productive reconversion.

MATERIALS AND METHODS

Data

The research was based on the production and harvesting conditions developed by hibiscus producers in association with maize in the municipalities of Ayutla de los Libres and Tocoanapa, state of Guerrero, Mexico, which are similar to those carried out by producers in the rest of the state (INIFAP, 2017). The information was obtained from databases and interviews with producers, specialists, and members of the National Hibiscus Product System National Committee during the first quarter of 2020. The databases consulted were the following: daily wholesale prices from 2015 to 2022 (SNIIM, 2022); yield and average rural price 2019 and 2020 (SIAP, 2022); production and harvest costs for 2016 (INIFAP, 2017) and 2020 (interviews with producers); national producer and consumer price index from 2016 to 2022 (INEGI, 2022); 28-day interbank equilibrium interest rate (TIIE) and exchange rate (BANXICO, 2022).

Methods

The investment to be analyzed was carried out under conditions of uncertainty about hibiscus flower prices, in which the option of continuing under a conventional production system, hibiscus in association with maize, or carrying out a productive reconversion under the same crop association, but with the objective of obtaining a higher quality product, is presented. Such reconversion implies the decision to increase the initial investment starting in period one, that is, after the start of the production cycle, and continuing on an annual basis.

Two methods were used. The focus group method was used to obtain detailed information on production costs. The binomial method was used to model both the investment decision and the impact of price volatility. Prior to the use of the binomial model, the volatility value was calculated statistically using an autoregressive integrated moving average (ARIMA) model with the statistical package STATA version 15 (StataCorp LLC, USA), which required data on daily hibiscus flower prices

(SNIIM, 2022). Maize prices were excluded from the volatility calculation because maize is used for household consumption. The investment strategy was modeled as a call option, which is explained below.

Real option strategy

Real options are defined as the extension of financial option theory applied to real assets. These grant the right, but not the obligation, to make future strategic decisions, i.e., expansion, abandonment, reduction, or any other decision that alters the value of a previously calculated project (Schawrtz, 2013).

The research focuses on the decision to expand the initial investment by an amount X′ and generate an additional expected income stream in the proportion "α". As indicated by Venegas-Martínez and Fundia-Aizenstat (2006), this decision has an option associated with the existing underlying project, so that if the additional amount X′ is invested, the present value is increased by the proportion α minus the additional investment at time T; that is, $(1+\alpha)\ S_T - X'$. In summary, the intrinsic value of the option is expressed as follows:

$$c\ (ST,\ T,\ \alpha,\ X') = max\ ((1+\alpha)\ ST - X',\ ST) \quad 1$$

$$= ST + max\ (\alpha ST - X',\ 0)$$

where $X = \frac{X'}{\alpha}$ and $c(S_T, T, \alpha, X)$ is the intrinsic value of a call option in which the expected cash flows S_t is "driven by a risk-neutral geometric Brownian motion" (Dixit and Pindyck, 1994; Venegas-Martínez and Fundia-Aizenstat, 2006):

$$dSt = r\ Stdt + v\ Stdzt$$

where v is the standard deviation of the continuous moving rates of expected cash flows; dt are the time increments; dz_t is the movement of a z random variable with normal distribution (0,1), which, under the assumption that $(dz)^2 = dt$ and $(dt)^2 = 0$, behaves as a Wierner process where E(dz) = 0 (Dixit and Pindyck, 1994); and r is the average of the continuous movement rate of the expected cash flows.

The application of logarithms allows the movement rates to be additive over time, approximately equal to the arithmetic calculation for short periods. Cash flows are assumed to be log-normally distributed, which does not allow negative values (Forero-Laverde, 2011):

$$r_t = ln\left(\frac{S_t}{S_{t-1}}\right)$$

Thus, the modified net present value ($\overline{VPN}$) of the project is equal to the net present value without the option (VPN) plus the value of the expanding option as of today (c) (Venegas-Martínez and Fundia-Aizenstat, 2006):

$$\overline{VPN} = VPN + c \qquad 2$$

The future price of the asset is an important variable in calculating the value of the option because it allows the calculation of the cash flows in question; however, these prices are not always available. Alternatively, the asset price is estimated by using an autoregressive model to calculate the volatility. The estimated disturbances of model (et) must comply with the characteristics of a stationary stochastic process $E(e_t) = \mu$, $var(e_t) = s^2$ and $cov(e_t, e_{t+s}) = \gamma$; that is, the mean, variance, and covariance of the disturbances must remain constant over time, so that they do not affect the behavior of volatility in the long run (Gujarati and Porter, 2010). Thus, the Box-Jenkins methodology was used for model identification, estimation, and verification.

The identification of the model allowed us to know the level of stationarity of the cash flow movement rate variable and the lag order of the parameters in terms of the autoregressive process of moving averages. Parameter estimation was performed using the maximum likelihood method. Finally, model verification included the Wald test to show the statistical significance of the model, and the Ljung-Box test to determine the statistical independence of the residuals (Gujarati and Porter, 2010).

One-period binomial model and valuation of real options

The first step in the valuation of a real option is the binomial projection of the S_t cash flows with risk-neutral probabilities p and 1-p, respectively (Figure 1). This variable can take in the period t=1 two possible values, uS_t and dS_t, in which the parameters u and d are constant through time and present values under the range $0 < d < 1 < u$.

As the simulation of the flows progresses, both uS_t and dS_t evolve through a multiplicative process, allowing each value to take one of two possible values: upward

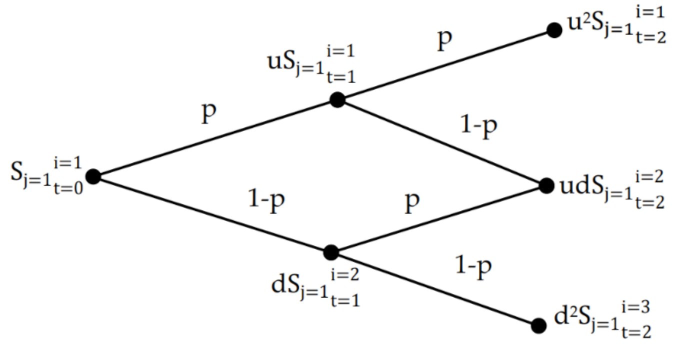

Figure 1. Binomial projection of cash flows S_t, where S^i_{jt} is the value of the binomial projection j at node i and period t.

(multiplied by u) or downward (multiplied by d). The values of u and d depend, among other variables, on the estimated volatility σ:

$$u = e^{\sigma\sqrt{\Delta t}}$$

$$d = e^{-\sigma\sqrt{\Delta t}}$$

where e is the exponential constant, Δt is the increase over a period of time, σ is the annual volatility of returns, and r represents the 28-day interbank equilibrium interest rate (TIIE).

Based on the values of the variables r, u, and d, the probabilities associated with the values of S_T, the cash flows recorded in the final nodes of the binomial projection are calculated using the following formula:

$$Prob\ (t,\ T,\ p) = \frac{T\,!}{(T - t)\,!\ t\,!}\ p^{t}\ (1\text{-}p)^{T\text{-}1}$$

where t is the number of nodes with probability p; T is the total number of periods; p is the probability that the value of the asset will increase, and therefore, that the producer will continue with the conventional production of hibiscus; and (1-p) is the probability that the value of the asset will decrease, and therefore, that the producer will decide to carry out the productive reconversion.

The second step is the calculation of c_t, the value of the real option at t. Based on the S_t cash flows recorded at the end nodes of the binomial model projection, the maximum value is selected (Equation 1). Then, through the process of backward induction, the value of the preceding node c^1_{t-1} is calculated as the updated value (by means of the expression $\frac{1}{1 + r}$), which results from the weighted sum of c^1_t and c^2_t by the risk-neutral probabilities p and 1-p, respectively (Figure 2). This procedure is applied until reaching the initial node c_0, the value of the option at the current date (Cox *et al.*, 1979).

The risk-neutral probabilities that the value of the asset S_t increases p or decreases 1-p are determined as follows (Cox *et al.*, 1979):

$$p = \frac{(1 + r) - d}{u - d}$$

$$(1 - p) = \frac{u - (1 + r)}{u - d}$$

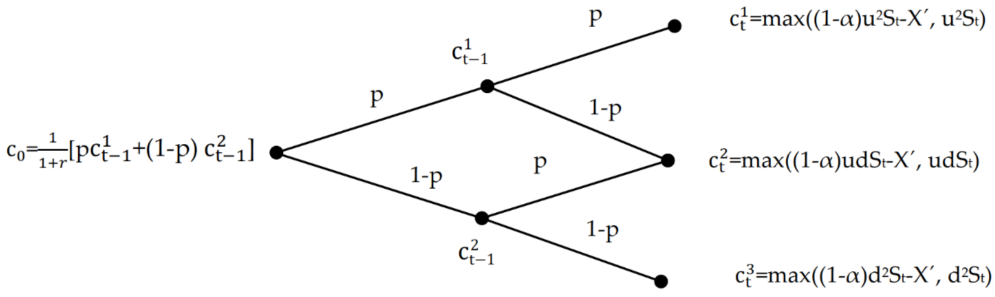

Figure 2. Calculation of the option value.

under the condition that $u > r > d$; otherwise, there are opportunities to make arbitrage trades in which a profit is earned (Cox *et al.*, 1979). Finally, in order to determine whether the productive reconversion is accepted, the value of the expansion option must be positive (Venegas-Martínez and Fundia-Aizenstat, 2006).

In summary, the steps followed in the present investigation are as follows: First, production and harvesting costs were determined for both conventional and quality production systems. After calculating the VPN of the conventional production system and the $\overline{VPN}$, it was determined whether the reconversion was a financially viable option for the producer. The conversion was modeled using the real options method, which proposed increasing the initial investment and generating an additional expected income stream.

RESULTS AND DISCUSSION

In the conventional production system, annual costs were $17 493 MXN ($908.38 USD), similar to those recorded by Caamal-Cauich *et al*. (2020) of $17 497 MXN ($908.59 USD), and significantly lower than the costs obtained under the quality production system of $32 742 MXN ($1700 USD) in the present investigation (Table 1).

Compared to conventional production systems, quality production systems have an annual cost increase of $15 249 MXN ($791.62 USD) because the producer invests in inputs that guarantee the quality and safety of the product (improved and disease-resistant seed, biofertilizers, biofungicides, food-grade netting, etc.), performs good agricultural practices (vermicomposting, manual weeding, pruning, biological pest control, etc.), and applies post-harvest practices that require a higher level of specialization for the conditioning of the product. Additionally, the producer invests in water collection systems due to the climatic conditions in the production area (INIFAP, 2017). In this regard, authors such as Gutiérrez-Guzmán *et al*. (2012) and Soto (2013) have pointed out that, as producers have fewer economic resources, the adoption of new production strategies becomes more difficult.

Table 1. Real average annual costs on per hectare of conventional and quality production systems (base year 2019).

Concept	System		System	
	Conventional	Quality	Conventional	Quality
	Amount ($MXN)		Amount ($USD)	
Land preparation	1503	1636	78	85
Sowing	867	2500	45	130
Weed control	1711	3600	89	187
Fertilization	1214	6322	63	328
Pest and disease control	2312	3200	120	165
Production activities	7608	17 258	395	895
Drying material	436	1202†	23	62†
Cutting and hauling	6135	6135	319	319
Detasseling	1677	5461	87	284
Packaging material	1636	1636	85	85
Harvest	9885	14 434	513	750
Water collection system		1050†		55†
Total cost	17 493	32 742	908	1700

† Costs are depreciated over seven periods or years.

The VPN of the conventional production system for seven periods was $57 077 MXN ($2963.9 USD) ($8154 MXN ($423.41 USD) on average per period), which was obtained from a revenue flow of $179 526 MXN ($9322.45 USD) and costs of $122 449 MXN ($6358.55 USD), respectively. The results show the benefit, and thus the viability, of carrying out this production system over a period of not less than seven periods (years) for hibiscus producers in Guerrero. However, if producers decided to convert to a higher quality production system, the additional investment would be $106 745 MXN ($5543.07 USD), an increase of 87 % over the costs of the conventional production system (Table 2).

Calculation of the real option value

Under the conventional production system, the farmer plants in year zero and harvests and markets his product in year one. In the same year, the farmer plants again to harvest in the following year. The decision on which system to continue with is made in year one. If hibiscus prices and, consequently, his income increase, the producer will continue with the conventional production system; if not, they will decide to convert production to generate a greater flow of income. The above decision is simulated using the binomial model. The real option showed that reconverting production is profitable if it is implemented in a period of no less than seven periods (start-up plus six periods in which product is harvested in each of them) under the condition that the volatility value does not change. The steps for calculating the option value are shown below.

Table 2. Actual flows (base year 2019).

Conventional production system of hibiscus in association with maize								Total
Year	2019	2020	2021	2022	2023	2024	2025	
Period	0	1	2	3	4	5	6	
INPC	0.028	0.032	0.074	0.067	0.037	0.037	0.037	
Real costs ($MXN ha^{-1})†	6580	15 860	18 131	19 915	22 015	25 030	14 918	122 449
Real costs ($USD ha^{-1})†	342	824	942	1034	1143	1300	775	6359
Real income ($MXN ha^{-1})¶	2582	22 465	23 232	27 104	30 625	34 533	38 985	179 526
Real income ($USD ha^{-1})¶	134	1167	1206	1407	1590	1793	2024	9322
VPN ($MXN ha^{-1})								57 077
VPN ($USD ha^{-1})								2964
Additional investment ($MXN ha^{-1})	9241	22 563	14 869	16 229	17 830	20 127	5885	106 745
Additional investment ($USD ha^{-1})	480	1172	772	843	926	1045	306	5543

† Real production and harvesting costs do not take into account production support and/or subsidies granted to producers by the Federal Government.
¶ Real incomes were calculated from 2020 real prices for hibiscus flower and maize of $28.2 MXN ($1.31 USD) kg^{-1} and $4.23 MXN ($0.2 USD) kg-1, respectively. For subsequent years, an annual price growth rate of 15.03 % and 19.97 % was used, respectively.

The first step was to determine the volatility of real prices for hibiscus flower, which is a relevant marketing product (Table 3).

The variables that were statistically significant were v_{t-1}, v_{t-10} , and e_{t-13}, so the model obtained is as follows $v_t = 0.012 + 0.191\, v_{t-1} - 0.253\, v_{t-10} - 0.486\, e_{t-13}$. Additionally, statistical tests were performed to show the significance of the model as a whole and the statistical independence of the residuals. The Wald test showed that the estimated model is statistically significant, and under the Ljung-Box test considering 39 lags in its calculation, a statistic with a value of 21.1 was obtained and a *p*-value of 0.994,

Table 3. ARIMA model (monthly data from 2015 to 2021).

Log maximum likelihood = 113.6034			Observations	83
			Wald $\chi2_{(3)}$	29.34
			Prob > $\chi2_{(3)}$	0
Variables	Coefficients	Standard error	z	Prob > z
constant	0.012	0.005	2.47	0.01†
ar				
v_{t-1}	0.191	0.100	1.91	0.06¶
v_{t-10}	-0.253	0.144	-1.76	0.08¶
ma				
e_{t-13}	-0.486	0.106	-4.59	0.00†
/sigma	0.060	0.004	14.43	0.00†

† Variables statistically significant at 1 %. ¶ Variables statistically significant at 10 %.

so the null hypothesis was not rejected, and it was concluded that the residuals are independent (Gujarati and Porter, 2010).

Through the model, the estimated value for volatility (v_t) for the first five months of 2022 was 0.1503, which is slightly lower than the estimated value for historical volatility of s = 0.1521, as well as the estimated values for other agricultural products (Ortiz-Rivera *et al.*, 2020; Valencia-Sandoval *et al.*, 2010; Delgado-Juárez and Pérez-Akaki, 2013; Valencia-Sandoval and Zetina-Espinosa, 2016). With interest rate values of r = 0.08, and parameters indicating that the expected income flow rises (u = 1.162) and falls (d = 0.860), the values of the risk-neutral probabilities of the binomial model were calculated. Thus, the probability that the price of conventional hibiscus will increase was p = 0.728, while the probability that it will decrease was 1-p = 0.272.

In the second step, two binomial projections were made. The first examines the revenue flow of the conventional system, and the second the revenue flow of the reconversion system. In this second projection, the amount of income was $451 722 MXN ($21 012.66 USD) at period one values (year 2020). These expected revenues were recorded under the second binomial projection, node 2 period 1 ($S_{j=2}{}_{t=1}^{i=2}$) to make their projection.

A third binomial matrix is obtained from the weighting of the two previous projections, i.e., each expected value of the revenue flow at node i period t is obtained as $E(S_{3}{}_{t}^{i}) = p\, S_{1}{}_{t}^{i} + (1\text{-}p)\, S_{2}{}_{t}^{i}$. The only value of the new matrix that is not weighted is $S_{j=3}{}_{t=1}^{i=2} = S_{j=2}{}_{t=1}^{i=2}$ = $451 722 MXN ($21 012.66 USD).

In the third step, the value of the expansion option was calculated, which is equivalent to an amount of $186 290 MXN ($9 673.69 USD) (Table 4). As explained in the methodology, the cash flows of the final nodes (period 6) were calculated from equation (1) and correspond to the maximum value that resulted between the difference of the cash

Table 4. Option value. Flow represented in $MXN ($USD).

Periods						
0 (2019)	1 (2020)	2 (2021)	3 (2022)	4 (2023)	5 (2024)	6 (2025)
						442 409
					388 787	(22 973.47)
				338 480	(20 188.96)	359 740
			292 883	(17 576.66)	303 519	(18 680.67)
		252 425	(15 208.87)	257 106	(15 761.19)	242 490
	217 013	(13 107.94)	218 493	(13 351.06)	208 646	(12 592.05)
186 290	(11 269.06)	186 160	(11 345.96)	179 526	(10 834.61)	179 526
(9673.69)	158 940	(9 666.95)	154 470	(9 322.46)	154 470	(9 322.45)
	(8253.44)	132 911	(8 021.35)	132 911	(8 021.34)	132 911
		(6 901.83)	114 361	(6 901.83)	114 361	(6 901.82)
			(5 938.56)	98 400	(5 938.55)	98 400
				(5 109.73)	84 667	(5 109.73)
					(4 396.58)	72 850
						(3 782.96)

flow recorded in each final node of the third matrix minus the additional investment (at period six values), and the income flow under the conventional production system. According to equation (1) and a volatility of 0.1503, the $\overline{VPN}$ in the present research is equal to $63 841 MXN ($3 315.14 USD); which indicates that if the reconversion is carried out, it will increase the value of the project today by $6 764 MXN ($351.24 USD) compared to the NPV. As volatility increases, so does the probability (1-p), resulting in a decrease in VPN, and hence, the $\overline{VPN}$ outperforms VPN in a time span of less than seven periods (Table 5).

Table 5. Relationship between Volatility and risk neutral probability 1-p.

V	Risk neutral probability		Periods	VPN	$\overline{VPN}$	VPN	$\overline{VPN}$
s	p	1-p	n	(values in $ MXN)		(values in $ USD)	
0.15	0.728	0.272	7	57 077	63 841	2964	3315
0.20	0.649	0.351	6	44 919	58 442	2333	3035
0.30	0.557	0.443	5	33 982	42 387	1765	2201

V: volatility.

Valencia-Sandoval (2010) obtained similar results using the real-options method. Faced with greater volatility in prickly pear market prices, the producer needs to generate a higher benefit-cost ratio, which can be achieved by adding value to the product. In contrast to Valencia-Sandoval (2010), this study not only linked, but also, using the real options method, showed the impact of price volatility on the decision to carry out a productive reconversion by low-income producers.

Piras (2009) pointed out that price volatility is an important factor for small-scale producers, so that while an increase in the probability associated with an increase in hibiscus prices induces them to continue with the conventional system, a fall in this probability increases the financial exposure of producers, inhibiting their desire to invest. As an alternative, Brown *et al*. (2008) and Delgado-Juárez and Pérez-Akaki (2013) pointed out that, in the case of coffee producers, they have sought productive differentiation as a way to avoid increasing volatility in the price of the conventional crop, since otherwise their ability to pay is affected due to the uncertainty of their expected income.

Finally, under the premise that productive reconversion should be profitable, the decision to carry it out is subject to elements such as the producer's initiative to carry out the reconversion, access of the product to the market (Hu *et al*., 2021), access to financing, technical assistance and training, establishment of the execution deadline, and access to producer organizations (Esquivel-Marín *et al*., 2022; IFAD, 2022; Schwentesius-Rindermann *et al*., 2014), among others.

CONCLUSIONS

A better understanding of the decision to carry out a given investment under uncertainty allows for the detection of signals about the impact of price volatility on the producer's investment decisions. The real options theory allowed us to show the financial viability of adopting a productive reconversion system for low-income producers who conventionally grow hibiscus in association with maize in no less than seven periods (years). Additionally, the impact of price volatility on the decision to carry out the productive reconversion was confirmed. An increase in volatility increased the likelihood that producers would face low prices for conventional hibiscus, and therefore, increased the incentive to adopt a higher-quality hibiscus-maize production system.

The findings of the current study are significant given the impact that various public and private institutions can have on the economic development of low-income producers who grow hibiscus in association with maize. Support for investments in assets such as water catchment systems and materials for product drying, as well as product quality certification, would encourage producers to convert production and thus gain access to better prices. The above assumes that the producer will continue with the same production rationality, i.e., the productive reconversion of hibiscus cultivation in association with maize.

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