AVOCADO (PERSEA AMERICANA MILL) INDUSTRIALIZATION AS A REGIONAL SUSTAINABILITY DEVELOPMENT STRATEGY

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ABSTRACT

Avocado production is a profitability and competitiveness business, is a job generator and is a healthy food. Food habits and tendency consumption is looking for nutraceutical and heathy products. There is an interest to get avocado oil for human consumption because its highly non-saturated fatty acids and the benefits in human health. The objective of this study was to evaluate the technical, financial and economic viability of an oil avocado plant. Information was obtained from 82 avocado producers belonging to three avocado local Associations. The study was carried on between 2015 and 2016. Productive and post-harvest productive chains methodology was used as a diagnosis tool and for the construction of SWOT matrix. Financial evaluation was determined with a five-year horizon. The commercial strategy, technical and financial design was integrated considering contributions from the partners, subsidies and financing. Finally, a risk analysis was carried out based on Net Present Value (NPV), Internal Return Rate (IRR), Cost-Benefit Ratio (CB/R) and Period recovery (PR) indicators, based on product sales prices. This analysis reported low uncertainty in contrast to the Minimum Return Rate of 13%, being the financial indicators: NPV of $ 217,448 USD; IRR of 25.4% and CB/R 2.26, PR of 3.0 years. The sensitivity analysis showed that the project can support a reduction in the sale price of up to 0.55 USD.

Keywords: *Avocado oil, Financial profitability, Local development, Sustainability*

1. INTRODUCTION

Mexico is the world's leader in avocado production (FAO-FAOSTAT, 2018). In 2016 the total volume of production was 1,889 thousand tonnes, in a total planted area of 205,250 hectares (507,183 acres) distributed in 28 States; Michoacan concentrates 72.32% of the planted area, followed by Jalisco with 9.51% and the State of Mexico 4.32%. The remaining 13.85% is distributed in the rest of the producing states (SIAP,2017). During this period the total production value was 30,265 thousand mexican pesos. (Cruz et al., 2013) mentions that crops such as avocado have a high added value, given they produce a great amount of job positions and generate profits. Of the national production, 69% is consumed fresh, 12% is exported and 19% is industrially used (Peña et al., 2015). The mexican per capita consumption, in 2017, was 7.0 kg (15.4 lbs) of fresh avocado (SIAP, 2017), although it is also consumed in several other presentations; salsa, guacamole and oil. Avocado is a greatly rich food, it contains a high proportion of monounsaturated fatty acids (MFA), a lower amount of saturated fatty acids (SFA) and no cholesterol. Approximately 60% of the fatty acids are monounsaturated, 20% are polyunsaturated and the rest are saturated (Pérez et al., 2005). This fruit is considered as a functional food and has been recognized as a source of energy, low in calories and sodium, with a high content of MFA, vitamin E, ascorbic acid, vitamin B6, β-carotene, potassium and more than 20 other essential nutrients (Restrepo et al., 2011). The commercial opening, the entering in different commercial trades and recently the bilateral trade with the United States, as well as the increasing demand for fruits and vegetables, the consumer trends and the promotion of sectoral, state and federal policies, that drive a productive reconversion towards fruits and vegetables, export crops by excellence, have boosted the avocado's expansion in Mexico. In this sense, the average annual growth rate (AAGR) with respect of the national surface, for the period 1980-2017 was 3.4% (SIAP, 2017). Nevertheless, simultaneous to the production volume increase, the pests and diseases also increased (Sangerman et al., 2014), as well as the loss associated with several factors such as: shrinkage due to maturation, damage caused by hits, fungus and bacteria, uneven maturation, fibrous pulp, product rapine and quarantine pests (NOM-FITO-066-2002), these factors demerit the price and limit the distribution in local markets, therefore alternatives for industrialization are required (Restrepo et al., 2012). In Mexico, an increased interest in the food industry has been shown in recent years, for the transformation of avocado in avocado oil, some of the properties of this raw product is their high smoke point, this high content of unsaturated fatty acids that lower the blood cholesterol (Pérez, et al., 2005), this and some other characteristics such as the percentage of proteins, carbohydrates, vitamins and minerals, grants its great nutritional value (Forero, et al., 2007). Avocado oil presents similar characteristics as olive oil (CODEX-STAN-033-1981; NMX-F-052-SCFI-2008) in addition to the content of unsaturated fatty acids ω3, ω6 of 759,292 mg/100 g, 12862,302 mg/100 g respectively and Vitamin E of 10,11 mg/100 g, which makes avocado oil a functional and highly nutritive feed (Yepes et al., 2016). The aim of this study was to evaluate the technical-economical viability of the investment project of extraction of avocado oil; in three municipalities in the State of Mexico, in the search for strategies that minimize the adverse effects of the increase in the production volume and that create a favorable development environment for the territorial scale, through industrialization processes with high value, and the technology transference to the avocado producers.

2. METHODOLOGY

This present study was conducted in the central region Mexico in the municipalities of: Malinalco, Ocuilan, and Tenancingo, located in the southeast of the State of Mexico, coordinates: 18º46´00" and 19º06´00" north latitude; 99º25´00" and 99º39´00" west longitude. The study area is located in the tropical deciduous forest, with the presence of different types of reliefs, soils, watersheds, arid and semiarid climates that promote biological diversity as well

as the agroecological and cultural diversities (INEGIa, 2009; INEGIb, 2009;INEGIc, 2009). The diagnostic was collected from the census of 82 producers of three avocado local associations in the three municipalities mentioned earlier, during 2014-2016. A questionnaire was used as a tool for collecting data, structured in two sections a) production; and b) postharvest. The evaluation was qualitative; during this process two workshops were imparted; the first one to the key producers of the participant municipalities and the second one to the technical assistance service providers and to the rural extension program evaluators. The information analysis used a logical process, building a SWOT matrix (strengths, weaknesses, opportunities and threats) of the links of the production line and postharvest, that defined action strategies oriented to use the strengths of the line, to take advantage of the existing opportunities at the surroundings and to mend the weakness that might be critical while facing the existing threads (Ponce, 2007), this derived in the seek for an added value with the project: Extra virgin avocado oil extraction. The investment project was structured according to the evaluation and project formulation methodology by (Baca, 2013). The analysis was determined in a five years horizon. The commercial strategy, technical and financial design was integrated considering contributions from the partners, subsidy and financing. The commercial strategy consisted in the analysis of four parameters: product, price, place and promotion, this methodology focuses its efforts in sales in order to insert itself to the market (INCA RURAL, 2003). For the product the following sections are considered: season when it is available, intrinsic quality, presentation, degree and type of transformation, market segment and available technology. In the case of the price, consisted in considering the market prices of the existing products in contrast with production costs. The place and promotion describe the marketing channel, it was considered wholesale channels the marketing channel and the type of product promotion for its insertion in the market (INCA RURAL, 2003, Baca, 2013). The project's technical viability was determined based on factors such as: land location, services and communication channel, product availability, urban centers of consumption. The land was located in the municipality of Ocuilan. It counts with services: water, electricity and phone line, the location is strategic with the places of production and with primary communication routes close to three urban centers of commercialization and consumption: México city, Toluca and Cuernavaca. The project's size was defined according to the availability of the raw materials and partner's resources, the production plant will start operations at 75% of its installed capacity, with 60 Tones of fresh product monthly, the extraction will be carried out by centrifugation in three ways. The proposed legal framework that protects the company is a SPR of RL (Rural Production Society of Limited Responsibility, acronym in Spanish) partially exempt of tax on rental income. The project consists of the establishment of infrastructure, machinery and equipment for the operation of a processing plant-extractor of virgin avocado oil for consumption (NMX-F-052-SCFI, 2008). The economical and financial profitability parameters were evaluated with a mixture of resources, 25% contribution of the partners, 25% small producers finance by FND, (2017), subsidy 50% Agrocluster component (DOF, 2016). The indicators used where those that consider money and time, such as: NPV (Net Present Value), IRR (Internal Rate of Return) C/B (Cost-Benefit ratio) MARR (Minimum Accepted Rate of Return) RP (Recovery Period). The economic and financial evaluation are valued concepts that express a company investment profitability and based on the results the implementation of a project can be accepted or rejected it also allows to select and evaluate different investment alternatives (Franco, et al., 2014). The NPV is a value updated by the discount rate or the prefixed update of the net price flow (Total costs - Total benefits) generated for an investment project. The Net Present Value is calculated according to the following formula, in discrete time and as long as the interest rate stays constant (Azqueta, 2007, Baca 2013).

$$NPV = \sum_{t=0}^{T} \frac{B_t - C_t}{(1+r)^t}$$

Where: B_t are the benefits of the year *t,* C_t the costs of that same year *t, r* the interest rate or the discount rate and *T* the contemplated project life. The decision rule in the economic evaluation of investment projects should be NPV equal or greater than zero i.e. the sum of the net present flows minis the investment costs in terms of their equivalent value at this time or zero time, must be equal to or greater than zero (Baca, 2013).

The Internal Rate of Return (IRR): Was evaluated based on a single rate return per period, with which the total of updated benefits is exactly the same than the disbursements expressed in current currency (Franco, et al., 2014). It is called Internal Rate of Return because allegedly the money earned year by year is totally reinvested. Meaning that, it is the rate of return generated entirely within the company through reinvestment. It is a calculated that makes the NPV equal to zero (Azqueta, 2007, Baca 2013).

$$NPV = \sum_{t=0}^{T} \frac{B_t - C_t}{(1+IRR)^t} = 0$$

If the IRR of an investment are above the interest rate that reflects the profitability of different alternatives (opportunity cost) the investment must be executed. The MARR (Minimum Accepted Rate of Return), was estimated based on the period inflation (BANXICO, 2017), more than 9 percentage points taxed to small producers FND, (2017), under the researcher's criteria under a constant production (Baca, 2013). The MARR calculated on this project was 13%. The Cost-Benefit ratio consists in the sum of the updated benefits divided by the sum of the updated costs, the calculus according to Franco et al., (2014) is done:

$$\frac{RB}{C} = \frac{\sum_{i=1}^{n} \frac{B_t}{((1+r)^t}}{\sum_{i=1}^{n} \frac{C_t}{(1+r)^t}}$$

B_t equals the benefit in each period of the project, C_t cost in each period of the project, *r* equals the update rate or discount rate, *t* equals periods in years. If the C/B ratio is above 1 it is acceptable (Baca, 2013; Franco et al., 2014). The Recovery Period (RP) the expected net flows of the updated project were used according to the expression used by Peña et al., (2015).

$$RP = Year\ prior\ total\ recovery\ + \frac{Cost\ not\ recocered\ at\ the\ begginig\ of\ the\ year}{NPV\ during\ the\ year}.$$

The sensitivity analysis was made on Excel 2008 spreadsheet like an hypothesis analysis considering the NPV. The indicators were evaluated based on the sales price of the final product.

3. RESULTS AND DISCUSSION

The SWOT matrix summarizes the main aspects that characterize the productive line of avocado and propose strategies on the short, medium and long term to add value to it, for its characteristics the avocado industrialization for oil production proved viable (Table 1).

Table 1: SWOT matrix (the authors)

Strengths (S) Favorable agro-climatic conditions for the avocado production. Cluster of supplies, machinery and equipment. Formally constituted, literate producers, average age 49 years. *Opportunities (O)* Capacity of adoption of technological improvements and innovation: cultivation phenology and nutrition, promotion of certification processes and application to GFP (Good Farming Practices), implementation of food safety programs. Selection, packaging and handling post-harvest. Processing and industrialization of the product and insertion to new marketing channels. Increasing national and international demand of functional products. Access to governmental subsidy and sources of credit and finance. *Weaknesses (W)* Small producers 1.0-5.0. "Ejidal and communal" regime. Temporal production system. Minimal degree of mechanization. Different production, density and age systems. Presence of pests and diseases. Ignorance of the phenology of the crop. Low added value due to the lack of infrastructure for: selection, packaging, postharvest treatment and avocado Deficient marketing channels, local markets, lack of certification and low quality of the fruits. Non specialized technical assistance. Difficulty accessing to credits and no risk prevention. Disarticulated productive chain. *Threatens (T)* Quarantine pest. Theft of the avocado fruit without physiological maturity. Opening of markets. Crop expansion and low quality of the product.	*Short term*. Training, integration and strategic planning of the associations in the areas of administration and production. Product industrialization and insertion to new marketing channels. Legal formalization of the partners on an association specialized on marketing and industrialization. *Medium term*. Elaboration of strategic marketing plans, for the access to subsidy and governmental credits. Product industrialization and insertion to new market channels. *Long term*. Selection and packaging (NMX-FF-016-2002). Start and implement certification process for GFP (NOM-EM-034-FITO-2000) and quarantine pest control (NOM.066-FITO-2002).

3.1. Commercial Strategy

3.1.1. Product

Raw avocado oil: fatty fluid, color slightly amber, extracted by mechanic means or physical means from the pulp and seed of the avocado tree fruit (*Persea americana*). Sensory characteristics: Characteristic product smell, slightly nutty, exempt of strange smells or stale, transparent fluid free of strange bodies at (293ºK) 20°C (NMX-F-052-SCFI, 2008). This product is marketed on an amber bottle on a 1.0 liter presentation. The chemical composition is presented in Table 2.

Table 2: Chemical composition of avocado oil (NMX-F-052-SCFI, 2008)

Fatty acids	Maximum	Minimum
Oleic acid C18:1 56 74	56	74
Linoleic acid C18:2 10 17	10	17
Linoleic acid C18:3 0 2	0	2
β-Sitosterol mg/kg	89	92
α-Tocopherol mg/kg	64	100

Avocado oil is offered to high to medium socioeconomic level consumers (Mora, 2016), age range between 35-55 years old (Solís, 2012; UAZ, 2015), who look for products that in addition to feeding them, contribute with intrinsic properties, without considering the price.

3.1.2. Price

This was fixed on $130.00 Mexican pesos according to the production costs and was compared with the average market price of existing products in supermarkets and online stores. On the other hand, the average price of the by product was fixed on $13.00 Mexican pesos, it was estimated based on the production costs.

According with the typology of the avocado consumer Solís (2012), consumers are more concern for their health than the product price point which ensures market acceptation.

3.1.3. Place and promotion

Starting with national sales. For the promotion the use of social media such as Facebook and a website are proposed, those tools represent an auspicious medium for the product's promotion. The product's name is Avocado oil *Ocuilli*.

3.2. Technical study

The production plant is located on the municipality of Ocuilan de Arteaga, the total surface is 10,000 m^2, the value of the property was estimated on $500 thousand mexican pesos. The location is strategic considering it is close to communication routes with Mexico City, Toluca and Cuernavaca and also with the producing municipalities; Malinalco, Ocuilan and Tenancingo. Its monthly productive capacity is 60 Tons of fresh fruit and the volume of production is 8,364 liters of oil, in a single turn, working only at 75% of installed capacity. This was determined by the producing volume of the partners and their contribution. The extraction of avocado oil was evaluated by a centrifugation process, utilizing the principle of differentiation between water and oil densities, this process is made on temperatures below 45ºC, (113°F) to preserve the nutritional properties of avocado, the expected performance is 60% of oil, this process is carried out according to the established on the (NMX-F-052-SCFI, 2008). For the operation of the project 3 administrative and 7 operative employees are required. The investment project includes the civil project, machinery and equipment. The legal framework of the organization is a SPR of RL (Rural Production Society of Limited Responsibility, acronym in Spanish) this type of societies are partially exempt of tax on rental income (SHCP, 2016).

3.3. Economic and financial evaluation

The investment project was a value of $ 3,715,8 thousands of Mexican pesos, the financial sources are SAGARPA with 50% of the total project through the subsidy Agrocluster, the 25% will be financed by Financiera Nacional de Desarrollo (FND, National Financial Development) with two types of credit; refractory $500 thousand pesos, and labour capital $1,205.7 thousand pesos, both fixed to an annual rate of 9%, this corresponds to the small producers program (Chard 2).

Table 3: Investment budget and financial sources (Thousands of Mexican Pesos) (the authors)

Concept	Amount	SAGARPA (50%)	Partner's contribution (25%)	FND (25%)
Fixed investment	2.500.1	1.000	1.000	500
Land	500	0	500	
Civil project	405	202.4	101.2	101.2
Machinery and equipment	1.595.2	798	399	399
Trade mark	50	25	25	
Deferred investment	10		10	
Organization expenses	10			
Labour capital*	1.205.7			1.205.7
Total	3.715.8	1.025	1.010	1.705.7

The marketing plan is linear from the first year of operations with $13.047 thousands of pesos for the concept of oil and $4.414 thousands of pesos for the sale of avocado paste as product

and by product respectively. This was obtained multiplying the liter price point ($130 pesos) by the average estimated production volume (100.4 m^3), with an annual total of $17.462 thousands of pesos. The operation costs are in straight line during the whole horizon of the project. The costs plan (Chard 3) summarizes, only the variable and fixed costs. In the conditions stated, the projected fixed costs were less than the variables, given the cost of the workforce. Thus, the annual costs (Table 4) for the first year are: total annual fixed costs $210 thousands pesos and total annual variable costs $14.258.5 thousands of pesos.

Table 4: Annual operation costs (Thousands of Mexican Pesos) (the authors)

Concept	Year 1	Concept	Year 1
Fixed costs	**210**	**Variable costs**	**14.258**
Salary	194	Supervisor	145.8
Energy	3.6	Asistent	61.5
Paper	6.0	Operator	1.782
Water	6.0	Raw material	10.080
Transportation	6.0	Packaging	1.806
		Box	144
		Water	225

The projection of investment (Table 5), depreciations and residual value (Chard 4), was made through the straight-line method, the only approved in Mexico for fiscal purpose (Baca, 2013, Peña et al., 2015). The applied labour capital is used at the beginning of the operations and it is amortized at the end of the first period.

Table 5: Investment, depreciations and residual value (Thousands of Mexican Pesos) (the authors)

Concept	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Fixed investments						
Civil project	404.9	20.2	20.2	20.2	20.2	20.2
Machinery and equipment	1.595		319	319	319	319
Labour capital	1.205					
Subtotal	3.205					
Accumulated depreciation		20.2	20.2	20.2	20.2	20.2
		319	319	319	319	319
Annual depreciation		20.2	40.4	60.7	80.9	101.2
		319	638	957	1.276	1.595
Total residue value						1.696

The information to determine the value of the profitability indicators are presented on Table 6 and, corresponds to the net flow of the project (NFP). Expenses estimates (costs and expenses) was expressed in this format and corresponds to cash flow (Baca, 2013). The calculation of the net flow of the project is; sales income minus total costs. The total costs are integrated by; fixed costs, variable costs, depreciations and interest rate on the credits. The profits before taxes or gross profits equals to the difference between total income and total costs. The project flow incorporates the tax discount plus profit distribution, depreciation, amortization of the credits, increase of fixed assets and labour capital, and investments, resulting in the net flow of the company (NFC).

Table 6: Net flow of the project (Thousands of Mexican Pesos) (the authors)

Concept	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Sales income		17.462	17.462	17.462	17.462	17.462
Total costs		14.962	14.841	14.834	14.826	14.817
Fixed costs		210.0	210.0	210.0	210.0	210.0
Variable costs		14.258.5	14.246.5	14.246.5	14.246.5	14.246.5
Depreciations		340.2	340.2	340.2	340.2	340.2
Interests		153.5	45.0	37.4	29.2	20.3
Gross Profit		2.499.6	2.620.1	2.627.6	2.635.8	2.644.8
Taxes		993.9	1.036.1	1.038.7	1.041.6	1.044.7
Distribution of profits to workers		283.9	296.0	296.7	297.6	298.5
Dep.+amor.+int.		493.8	385.2	377.7	369.5	360.6
Increase to labour capital		0	12.0	0	0	0
Investments	(3.715.8)					
NFP	(3.715.8)	1.715.4	1.685.2	1.669.8	1.666.1	1.662.1
Financial flow	(3.715.8)	1.442.7	128.5	128.5	128.5	128.5
Capital		1.289.2	83.5	91.0	99.2	108.2
Interests		153.5	45.0	37.4	29.2	20.3
NFC	(3.715.8)	3.158.2	1.813.8	1.798.4	1.794.7	1.790.7

To calculate the updated flow, the bank interest rate 9% minus the inflation of the period 5.28% was used. From the resulting difference the second discount rate, plus 1 equivalent to the update factor (UF) was obtained. This updated discount rate 13.01% was applied in the last column of the Table. This project maintains its economic life due to the expected positives cash flow (Peña et al., 2015). Summarizing, the IRR 25.4% (Table 7) was superior to the MARR, so, based on this indicator this project should be accepted. By definition the IRR is the updated rate that makes NPV to equal zero, and this method means that the partners have the opportunity to reinvest their cash flow in their own internal rate of return to generate the monetary profitability through the NPV (Peña et al., 2015). The real profitability (Baca, 2013) of the project is obtained by subtracting the MARR minus IRR, so 25.4 % - 13 % = 12.4 %.

Table 7: Profitability indicators (the authors)

Indicator	Value	Definition and rule of decision	Rule of decision
NPV	3,979,3	VAN >0 Represents the utilities of the investors	Most be accept
IRR	25.4	TIR > than TREMA	Most be accept
C/B ratio	2.26	B/C > 0	Most be accept
RP	3.0	3<5	Most be accept

Meanwhile, the C/B ratio obtained was greater than the 1. Under these criteria the project is accepted for being greater than one. Meaning that during the economic life of this project for every peso invested in the project, the company will receive 2.26 pesos of total benefits. Based on the RP, the number of years required to recover the original investment, the project must be accepted, therefore under the conditions stated above, the avocado oil project will be paid in less than three years (Table 7). The sensibility analysis of the project showed a price reduction in the main product of $ 10.0 Mexican pesos and a byproduct of $9.0 Mexican pesos.

4. CONCLUSIONS

According to the profitability indicators: NPV of $ 217,448 USD; IRR of 25.4%; CB/R 2.26, PR of 3.0 years, the project is viable. The project is sensitive to variations in price, sales, volume and other independent variables, but does not affect, in a risky manner, the profitability indicators. It supports a reduction in the sale price of up to 0.55 USD. The implementation of the project can promote territorial Sustainability development in the production system and in the political, infrastructure and agroecological area.

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