

Logistics Strategies Assessment for Small Coffee Producers in Chiapas, Mexico

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Abstract— Coffee production represents the livelihood of many peasant families in underdeveloped countries. In Mexico, coffee production has social, ecological, and economic significance. However, the Mexican industry coffee needs to determine a logistic strategy for improving its competitiveness. This work proposes a methodology to help coffee producers in Chiapas, Mexico. This methodology has four stages. First, done SWOT Analysis to understand the environment of the coffee sector from a literature review. Second, from SWOT analysis, a survey was designed. An expert group in coffee production linked to Chiapas coffee producers answered this survey. Cronbach's alpha coefficient was used to validate answers. Third, external and internal factors matrices were assessed by define generic strategies. Finally, it selected the best option from the Quantitative Matrix of Logistics Strategies. The results show several areas of opportunity for coffee producers concerning strengths and opportunities. In fact, the resulting logistic strategy is oriented to increase the participation of coffee products in the current market. This is proposed to make a differentiation of the brand through the denomination of origin and geographical indication.

Keywords— External and Internal Factors Assessment, Quantitative Matrix of Logistics Strategies, Subjective to Objectives Factors Conversion

1. Introduction

Coffee production represents the livelihood of many peasant families in underdeveloped countries. In Mexico, coffee production has social, ecological, and economic significance. Small Mexican producers are generally not organized, making it difficult for them to design effective strategies that address their specific needs [1]. They are often affected by the prices of coffee quoted in the international market. Production surpluses normally influence these prices. Cherry coffee is

normally sold at low prices, and oversupply makes its price drop even more [2]. Therefore, in most cases, the producer's income is only enough to pay for the work of product harvest.

In 2020, 710.4 thousand coffee crop hectares were planted in Mexico and collected 953.87 thousand tons. This represented a lower yield per hectare (1.5 t/ha) than the last reached in 1990 (2.8 t/ha) [3]. However, Mexico imports 50.9 million tons of coffee from Vietnam, Brazil, and Honduras [4]. Coffee is planted in 480 municipalities in Mexico, half of them located in marginalized rural areas, mainly ubicated in the Mexican southeast [5]. Chiapas is the national leader in the Mexican production of conventional and organic coffee [6] and has 183,761 coffee producers that produced around 40% production of the country [7]. In 2020, Chiapas planted around 252.6 thousand hectares (60% more than in the 90s). Nevertheless, in two decades, the yields annual production decreased by 2.1 t/ha [3].

This decrease in the production and coffee cultivation yield in Latin America is attributed to multiple factors as economic pressures due to the volatile macroeconomic environment, fluctuations in world coffee prices, rising production costs, labour shortages, increasing labour costs, decreasing availability of land for new coffee plantations, climate change, increased diseases and pests, low productivity, a weak organizational capacity of small coffee producers, limited research and development potential, weak technology transfer, limited generation of added value, and not take advantage of the opportunities that arise in coffee production and commercialization [8][9].

To help the coffee producers of Chiapas to improve their current situation. This research proposes a

four-stage methodology. First, a SWOT matrix is made from an analysis of the literature. Second, a group of experts help us validate this SWOT analysis based on the response to a survey. Third, we use the internal and external factor matrices to define a strategy. Finally, we select the best option from the Quantitative Matrix of Logistics Strategies.

2. Literature review

A Supply Chain (SC) is a global network of organizations that cooperate to offer products and/or services from raw materials to end customers through flows and information, physical structures, and funds [10]. The management of the CS consists of a set of practices necessary to carry out its functions properly [11]. Proper CS management can lead to a competitive advantage for those involved in the era of globalization. However, all CS faced various challenges. The CS of agricultural products face challenges in terms of transport of inputs and products [12], quality of information exchange that contributes to their agility and sustainability [13], among others. A first step for generating and exchanging information is identifying the stakeholders and their needs [14].

Most stakeholder-focused research focuses on high-power actors, leaving producers out [15]. Most of them only work within their family circle and have no knowledge or experience managing a business [16]. However, [15] focus on the participation of low-power stakeholders in the coffee industry, demonstrating that CS can design empowerment strategies that lead to more effective participation of all stakeholders. Only in this way will it be possible to improve crop productivity and increase producers' income, turning them into active commercial partners [17, 18].

The literature shows that the strengthening of alliances that allow the joint development of the market instead of competition can reduce complexity by improving the performance of operating costs and the response of suppliers [19]. The durability of products generates a sustainable competitive advantage for coffee producers [20]. Preference and value creation significantly affect the global SC of coffee [21]. The distribution and transportation of coffee are useful in identifying SC disintegration and leading to different results with high costs and low yields [19].

3. Methodology

This study is both exploratory and descriptive. The methodology used for carrying out this research is shown in Figure 1.

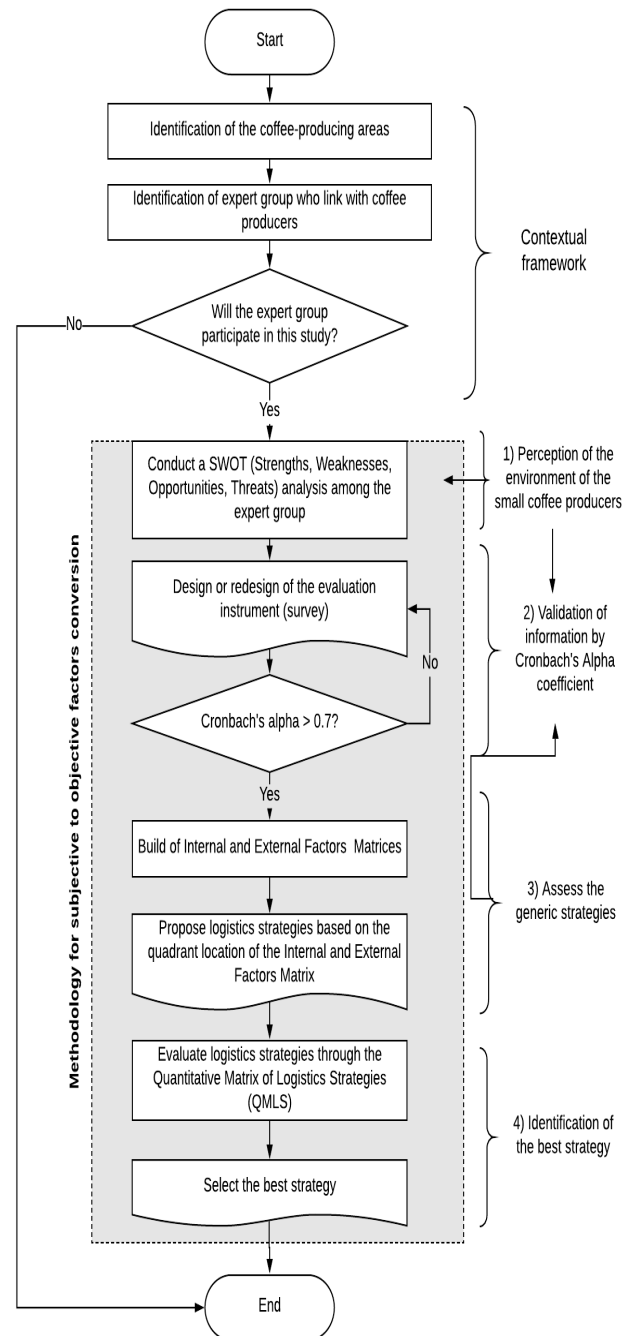


Figure 1. Methodology to assess logistics strategies for the small coffee producers in Chiapas-Mexico. Source: own elaboration.

First, a comprehensive search of the literature helped to determine key factors of coffee production. The INCA Rural Chiapas report was one main referent [22]. With it we prepare a questionnaire. Second, this questionnaire was answered by an expert group in coffee production,

all they are working with producer in the south-southeast region of Mexico, where Chiapas is located. A SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats) was used to diagnose the current situation of small coffee producers in Chiapas. To do this, we identify the main key factors for coffee productivity through a literature review. Second, a SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats) was used to diagnose the current situation of small coffee producers in Chiapas. To do this, we identify the main key factors for coffee productivity through a literature review. Then, we classified these key factors into the SWOT matrix. Next, to enhancing the SWOT analysis development, the researchers proposed to integrate other study methods and techniques associated to decision making such as the Analytical Hierarchy Process (AHP), onwards AHP-SWOT [23,24]; Diffuse Analytical Hierarchy Process (FAHP), onwards FAHP-SWOT, Analytical Network Process (ANP), onwards and ANP-SWOT [25]. These techniques help to evaluate the factors depending on their importance. Also, we could use other tools such as PEST (Political, Economic, Social and Technological factors) analysis [26], Porter's five forces analysis [27,28], or the 3C (Company-Client-Competitor) analysis [29]. Third, the Internal and External Factors Matrices were used to assess the generic strategy. Finally, a Quantitative Matrix of Logistics Strategies help us to identify the best strategy to follow by coffee producers in Chiapas.

3.1 WOT Analysis and Survey Information Validation

We classified key factors into strengths, weaknesses, opportunities, and threats to integrate the initial SWOT analysis. SWOT-analysis helps to diagnostic the micro-environment and macro-environment that front the small coffee producers. However, the first approximation of this analysis is based on subjective perceptions of researchers who classified the key factors found in the literature into SWOT-analysis quadrants. That is, these factors are not classified according to the importance of the producers or the study region [30,31].

With the SWOT matrix, a questionnaire was structured with the intention that it was the group of experts who, according to their experience, would rate the importance of the factor for the sector in general and the status of that factor for the coffee sector in Chiapas in particular.

The answers obtained from the expert group were

validated with Cronbach Alpha Coefficient. The Cronbach Alpha Coefficient estimates the reliability or consistency of a scale or test [32–34]. Cronbach's alpha is a measure of the correlations between the variables (equation 1).

$$\alpha = \frac{K}{K-1} \left[1 - \frac{\sum s_i^2}{s_x^2} \right] \quad (1)$$

where α = Alfa de Cronbach, K is the item number, s_i^2 is the variance of each item where $i = 1, \dots, K$ y s_x^2 is the variance of all items on a scale [32,35]. The equation result is the coefficient that provides evidence that scale or test constantly measures the same. So, when this parameter takes a value between 0 to 7, the instrument or answer is rejected for insufficient quality; values between 7 to 8 indicate acceptable instrument; values between 8 to 9 demonstrate a good instrument or quality answer; while values between 9 to 10 is evidence of excellent instrument quality or its answer [32,36,37].

3.2 External and Internal Factors Assessing

The Internal and External Factors Matrices allow organizations to know their current situation, these are also useful to perform a strategic scan of the organization [38,39]. In this case, these help us to know the environment of small coffee producers. This knowledge is useful for designing strategies that improve overcome market competition.

SWOT analysis is a baseline to build these matrices. Strengths and weaknesses are internal factors, while opportunities and threats are external factors [39,40]. The assessing of these matrices is done by performing the subsequent steps:

1. Enumerate the factors corresponding to strengths and weaknesses.
2. Establish assignment values between 0 and 100 for each key factor according to its relationship with the coffee production process, that is, how important it is for competitiveness. After that divide, the assignment values by 100. The sum of all the weightings must be the unit.
3. Assign a value between 1 and 4 to indicate a level that represents those key factors respond to current strategies: (4) strategies in a superior way, (3) above average, (2) average, and (1) poor.
4. Multiply the weight assigned to each factor by its corresponding value, to determine its weighting factor.
5. Add the weighted scores of each factor to

determine the total weighted organization score. The result obtained corresponds to the abscissa axis.

6. Repeat the points (a, b, c, d, and e) but now with opportunities and threats. The result will correspond to the ordinate axis.
7. According to abscissa and ordinates axis coordinates, the section in which they intersect is located (figure 2). Section 1 corresponds to quadrants I, II or IV. Section 2 quadrants III, V and VII. Finally, section 3 quadrants VI, VIII, and IX.

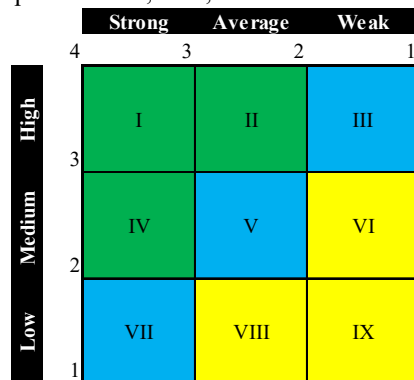


Figure 2. Sections to locate the internal and external weighting factors [41].

3.3 Identification of the Best Logistics Strategy

A set of logistics strategies obtained from the internal and external factors matrices is proposed. The logistics strategies are evaluated through the Quantitative Matrix of Logistics Strategies (QMLS) that integrates five steps:

1. Assign a value to each strength, weakness, opportunity, and threat according to their importance in small coffee production; the sum must be two;
2. Assign to each key factor, a value between 1 and 4 to establish an attraction grade (AG) score according to the relationship degree that it has with the strategy;
3. Calculate the total attraction grade that is a value product multiplied by attraction grade score;
4. Perform the sum of the (AGT) column, corresponding to each strategy; y
5. Select the highest score strategy.

4. Discussion and results

This section shows the results obtained from the proposed methodology. These are organized according to the stages of the proposed methodology.

4.1 SWOT Analysis and Survey Information Validation

Strengths, weaknesses, opportunities, and threats from interviews with an expert group and the literature review (Table 1) were identified.

Table 1. SWOT analysis of the environment of small coffee producers in Chiapas-Mexico. Source: Own elaboration.

Strengths
Producers' experience in sowing and harvesting.
Suitable geographical and climatic conditions.
National coffee recognition.
Polyculture.
Family resilience.
Agro-biodiversity conservation.
Weaknesses
Outdated installations (low production).
Lack of technical knowledge for coffee crops care.
Non-involvement of youth.
Public policy not specific to the sector.
Inadequate infrastructure.
Low-value-added to products.
High production costs.
Product non-accessibility.
Lack of technology.
Quality standards.
Lack of conditions to consolidate a business culture.
Lack of alliances.
Low coffee price.
Lack of economic resources for small producers.

Opportunities
Opening of specialty markets (organic, gourmet).
Local associations and organizations.
A wide number of organic certifications.
Increase in coffee consumption worldwide.
New strategies for cultural practices in coffee crops.
Threats
Lack of interest and youth migration.
Negative market speculation.
Companies that offer coffee substitutes with low prices.
High national and international competition.

According to Cronbach's alpha coefficient with a value of 0.89, the survey applied to the experts' group is reliable and valid. Therefore, it can be said that the survey or its answers adequately measures the situation of coffee crops in the state of Chiapas (equation 2).

$$\alpha = \frac{K}{K-1} \left[1 - \frac{\sum s_i^2}{s_x^2} \right] = \frac{29}{29-1} \left[1 - \frac{25.1}{178} \right] = 0.9 \quad (2)$$

4.2 Internal and External Factors Matrices

The Internal and External Factors Matrices was created with the data collected through the survey. According to experts' group criteria, it was assigned a weight and value to each variable to determine the weighting factor (Table 2).

Table 2. Internal Factors Matrix for small coffee producers.

Strengths	Weigh	Value	Weighting
Producers' experience in sowing and harvesting	5.50	3.12	0.17
Suitable geographical	6.00	3.00	0.18

and climatic conditions			
National coffee recognition	5.50	2.75	0.15
Polyculture	5.75	2.50	0.14
Family resilience	4.00	2.50	0.10
Agro-biodiversity conservation	4.25	2.37	0.10
Sum 1	31.00	16.25	0.84
Weaknesses			
Outdated installations (low production)	5.00	1.62	0.08
Lack of technical knowledge for coffee crops care	5.31	2.00	0.10
Non-involvement of youth	4.18	2.12	0.08
Public policy not specific to the sector	4.93	2.12	0.10
Inadequate infrastructure	8.00	1.62	0.13
Low-value-added to products	4.31	1.25	0.05
High production costs	4.18	2.12	0.08
Product non-accessibility	3.81	2.00	0.07
Lack of technology	4.87	1.62	0.07
Quality standards	4.06	2.12	0.08
Lack of conditions to consolidate a business culture	3.75	1.75	0.00
Lack of alliances	5.18	1.25	0.06
Low coffee price	6.12	1.75	0.10
Lack of economic resources for small producers	5.25	1.37	0.07
Sum 2	69.00	24.75	1.20

The opportunity with a greater weighting factor is the increase in coffee consumption worldwide, and its primary threat is the high national, and international competition in the coffee crops and other products obtained from coffee (Table 3).

The sum of weighting factors is 2.40 (ordinates axis), which means that producers respond to opportunities and threats in the coffee industry. However, the strategies are not fully adequate to take advantage of the opportunities to minimize the adverse effects of the threats.

Table 3. Opportunities and Weaknesses Analysis of small coffee producers with External Factors Matrix.

Opportunities	Weigh	Value	Weighting
Opening of specialty markets (organic, gourmet)	13.43	2.87	0.38
Local associations and organizations	8.68	2.37	0.20
A wide number of organic certifications	8.68	2.75	0.23
Increase in coffee consumption worldwide	17.5	3.37	0.59
New strategies for cultural practices in coffee crops	9.56	2.37	0.22
Sum 1	57.87	13.75	1.64
Threats			
Lack of interest and youth migration	12.25	1.5	0.18
Negative market speculation	9.75	1.62	0.15
Companies that offer coffee substitutes with low prices	9.25	2.00	0.18
High national and international competition	10.87	2.12	0.23
Sum 2	42.12	7.25	0.75
Sum 1 y Sum 2	100.00	21.00	2.40

Finally, the coordinates obtained from the weights were (2.05, 2.40) when locating the point in the 9-

cell diagram, it was in cell V (figure 4), which corresponds to the set of quadrants (III, V, and VII). In this way, the logistics strategy for small coffee producers in Chiapas-Mexico, according to the literature review, is: "the company must maintain and rely on market penetration and product development" [38,40].

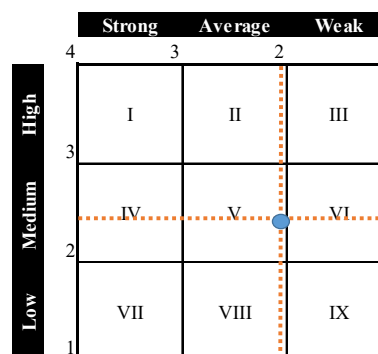


Figure 4. Quadrant location concerning to External and Internal Factors matrices coordinates.

Some strengths for the coffee crops in Chiapas, Mexico are the geographical and climatic conditions. While the inadequate infrastructure in the production units, as well as the lack of technical knowledge for plant care, represent two main weakness for the coffee growers.

The total sum of the weighting between strengths and weaknesses was 2.05 (abscissa axis), which means that how coffee growers are facing their weaknesses and taking advantage of their strengths is below what is required, that is, the variables that stand out above the others are not taking advantage, and their weaknesses are growing.

According to the results, two logistics strategies were proposed, considering the problems, infrastructure, market, and society.

Strategy 1. Market penetration: increased participation of current products in current markets [42] through increased marketing effort:

- Brand differentiators: carry out an exhaustive analysis of the market (competition, regulations, best distribution channels, quality, prices, consumer tastes and needs, and potential customers) to offer a quality service that makes a difference in such a way to develop a brand [43].

- Prices: adjust prices based on the minimization of the cost because competitiveness is sought by offering higher quality items at the same price or products of the same quality at a lower price to generate higher income [44].
- Alliances: producers with a business vision can create new synergies to enter the market to create a brand or even merge [39].

Strategy 2: Product development and product diversification: increase sales, improve the present of products, or services/develop new products or services.

- New product launching, it is strategic to know the client's consumption habits and know the type of products they buy. The new product must correspond to the highest demand and trends [45].

4.3 Quantitative Matrix of Logistics Strategies

The Quantitative Matrix of Logistics Strategies (Table 4) determined that the best strategy for small coffee producers is to have the highest score, corresponding to strategy number two.

The strategy refers to the fact that small coffee producers must increase the participation of their products in current markets through a greater marketing effort. This means that they must expand their range of products offered to the market or add value to them; generally, small producers sell cherry or parchment coffee without giving it any process. Also, it must work concerning the minimization of the cost to be more competitive in the market.

Table 4. Quantitative Matrix of Logistics Strategies (QMLS).

Key factor	Value	Strategy 1		Strategy 2	
		AG	AGT	AG	AGT
Strengths					
Suitable geographic and climatic conditions	0.06	2.60	0.16	2.6	0.16
Polyculture	0.058	1.80	0.10	3.00	0.17
Producers experience in	0.055	3.20	0.18	3.60	0.20

sowing and harvesting					
National recognition of coffee	0.055	4.00	0.22	3.40	0.19
Agrobiodiversity conservation	0.043	2.60	0.11	3.00	0.13
Family resilience	0.04	3.20	0.13	2.00	0.08
Weaknesses					
Inadequate infrastructure	0.08	4.00	0.32	3.20	0.26
Low coffee price	0.061	3.80	0.23	2.60	0.16
Lack of technical knowledge	0.053	2.20	0.12	3.40	0.18
Lack of producer's economic resources	0.053	3.80	0.20	3.60	0.19
Lack of alliances	0.052	3.40	0.18	2.40	0.12
Obsolete production plants	0.05	2.60	0.13	3.60	0.18
Public policies not specific to the sector	0.049	3.20	0.16	2.60	0.13
Lack of technology	0.049	3.00	0.1	3.80	0.19
Little added value to products	0.043	3.00	0.13	3.60	0.16
Non-involvement of youth	0.042	3.00	0.13	2.80	0.12
High production costs	0.042	3.00	0.13	2.60	0.11
Undefined quality standards	0.041	3.00	0.12	3.60	0.15
Product non-accessibility	0.038	3.20	0.12	3.20	0.12
Lack of conditions that consolidate a business culture	0.038	3.40	0.13	3.00	0.11
Opportunities					
Increased coffee consumption	0.175	3.80	0.67	3.80	0.67
Opening of specialty markets	0.134	3.80	0.51	3.60	0.48
New strategies for cultural practices	0.096	2.40	0.23	3.60	0.34
Local associations and organizations	0.087	3.20	0.28	1.80	0.16

A wide number of organic certifications	0.087	3.20	0.28	3.60	0.31
Weaknesses					
Lack of interest and migration	0.123	3.00	0.37	2.60	0.32
High competition	0.109	4.00	0.44	3.40	0.37
Negative market speculation	0.098	3.40	0.33	2.80	0.27
Companies that offer coffee substitutes	0.093	2.80	0.26	3.20	0.3
Sum of Attraction Degree Score	2.00		6.48		6.31

5. Conclusions

With the proposed methodology, we find that small coffee producers in Chiapas must resort to explicit and long-term logistics strategies to generate actions from all processes towards a common objective and take advantage of the opportunities offered by the markets.

Agricultural producers occupy a crucial role in Mexico's economy because they are the ones who supply food and raw materials to the population. However, due to their characteristics and logic of operation, they do not have an explicit strategy to face the challenges of the current economy in most cases.

This methodological proposal named "Subjective conversion factors to objective factors" helped identify logistics strategies for small coffee producers. These strategies are useful in support decision-making for small coffee producers by obtained indicators.

The methodological proposal complements the SWOT analysis by provided subjective factors about the current situation of small coffee producers in Chiapas-Mexico. In addition, the Cronbach's alpha coefficient helped to check the reliability and consistency of the answers of the instrument applied to the expert group in coffee cultivation into study territory.

External and Internal Factors Matrices helped us to define the generic strategies for small coffee producers. At the same time, the Quantitative

Matrix of Logistics Strategies helped us define the best strategy for small coffee producers to increase their market share through brand differentiation and cost minimization through joint planning or alliances with producers with the same business vision.

Future research should focus on the participation of all economic agents from all the value chain links to define a strategy under different perspectives from coffee growers. Likewise, it would be convenient to apply the methodological proposal for building strategies for other sectors or other agricultural production systems.

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