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Supply Chain and Economic Viability of *Vanilla planifolia* Andrew Production: A Case Study

Garza-Morales, Rodolfo[1]; Banda-Ortiz, Humberto[*2]; Vázquez-Trujillo, Katia[1]

[1]Universidad Autónoma de Nuevo León, México. [2]Universidad Autónoma de Querétaro, México
***Corresponding Author**: humberto.banda@gmail.com

ABSTRACT

Objectives: To characterize the supply chain of vanilla (*Vanilla planifolia* Andrew) in order to detect areas which could be improved and to determine the economic viability of its production.

Design/Methodology/Approach: The information was compiled through semi-structured interviews in a vanilla company. The Value Stream Mapping technique was used to describe the supply chain. Additional databases were consulted in order to obtain information on the production and commercialization of vanilla. The economic viability of vanilla production was analyzed with IRR.

Results: This case study had five phases in its supply chain. The IRR of cash flow in the traditional and technological production systems were positive, although the IRR of the traditional system was greater even though it had lower production volumes.

Study Limitations/Implications: It was observed that vanilla requires between 3 and 4 years for its first harvest, independently of the production system, traditional or technological, which means that there are negative cash flow numbers during the first two years in both systems, despite a positive IRR.

Findings/Conclusions: The critical stage in the supply chain of the company studied was the production. The cash flow for the technological system was superior when compared to the traditional system. However, the IRR for the technological system was lower, since the investment in shade cloth was not compensated by the discounted cash flows that could otherwise be obtained.

Keywords: value chain, IRR, vanilla.

INTRODUCTION

Vanilla (*Vanilla planifolia* Andrew) is native to Mexico, which was the sole producer during several centuries. Mexico benefited from the global monopoly of vanilla during colonial times. However, once the production was taken up in other countries thanks to the technique of manual pollination, described by Edmon Albius in 1836, and the principal component of its flavor and aroma was isolated by Nicolas-Theodore Gobley in 1958, the country started losing its international presence.

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Vanilla was primarily cultivated in the Papantla region, in the north of the state of Veracruz. Currently it is also cultivated in Chiapas, Oaxaca, Puebla, and San Luis Potosí. Vanilla is one of the most expensive species worldwide, and could cost up to $500 USD per kilogram. However, vanilla production in Mexico has decreased in recent years and was surpassed in production by Madagascar and Indonesia, which are the principal producers worldwide; nevertheless, there are ample opportunities for commercialization at a national and international level.

Some of the factors which have limited the expansion of Mexico's vanilla production are: the price of artificial substitutes, climate change, insecurity and product theft, and the damage caused by *Fusarium oxysporum* which causes mortality and limits the useful life of the areas cultivated. For Chopra and Peter (2008), the supply chain is integrated by all of the parties involved, either directly or indirectly, in order to satisfy the needs of clients. The agrifood supply chain, AFSC or FSC (Agri Food Supply Chain or Food Supply Chain) is responsible for the production and distribution of plant and animal products. This includes activities such as sowing and harvesting, processing, quality control, packaging, storage, transportation, distribution and commercialization (Granillo *et al*., 2012).

Van Der Vorst (2006) mentions that there are two primary food chains: that of fresh products and that of processed products. Additionally, Jeffee *et al*. (2010) propose that modern agrifood supply chains are networks that integrate the flow of physical and financial products, as well as information. When characterizing the agrifood supply chain, the following studies stand out: Ariadna *et al*. (2009), Castro and Colmenares (2011), Vargas Canales *et al*. (2015), and Bermúdez Avendaño (2016); these studies used surveys as methodology. Similarly, authors such as Cáceres and Escobar (2006) and Hernández-Mogollón *et al*. (2011) reference the Supply Chain Operational Reference Model (SCOR) for the characterization of the chain. In addition, other researchers such as Beshara *et al*. (2012) use a simulation technique. Based on the aforementioned, the objective was to characterize the supply chain of vanilla (*Vanilla planifolia* A.), to detect areas which could be improved and to determine the economic viability of its production in order to boost the sowing and harvesting process in Mexico.

MATERIALS AND METHODS

The methodology included two parts. In the first part the tools used to describe the supply chain were established, and in the second the techniques used to analyze the economic viability of its production.

Once the techniques used by different authors in order to describe the agrifood supply chain were analyzed, it was decided to carry out a field study by using semi-structured interviews with the actors involved in the vanilla supply chain. It should be noted that the semi-structured interview technique was chosen because it allows for flexibility while keeping with a basic interview structure. Questions were divided into two parts. The objective of the first part was to get to know the system of sowing, recollection, distribution, and customer service. The aim of the second part was to determine the implicated costs and income obtained. The members of the Santa Beatriz Ranch in Papantla, Veracruz, Mexico were interviewed.

After the interviews were carried out, the Value Stream Mapping (VSM) technique was used in order to graphically observe the specific actions that were required to cultivate vanilla and get it to the final client. Through the four stages of VSM (Figure 1), it was feasible to detail and to understand the flow of raw materials and of the information required in the process, as well as to map the activities which did or did not generate additional value, with the aim of finding areas which could be improved and reducing economic losses which could be generated in the process.

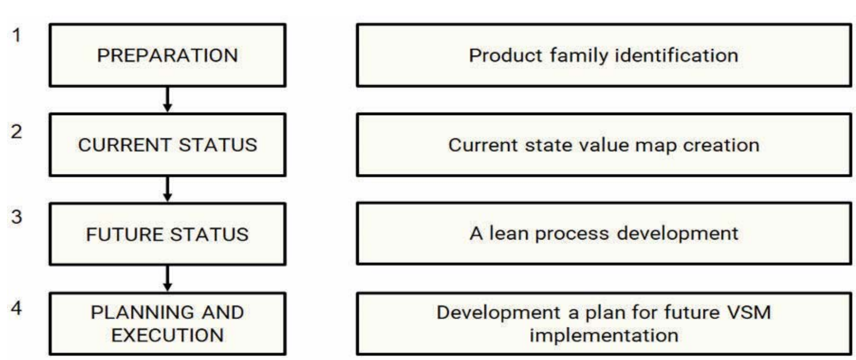

Figure 1. Stages of Value Stream Mapping (VSM). Prepared by authors based on Locher (2008).

By using sources such as SIAVI (from Spanish, *Sistemas de Información Arancelaria Vía Internet* or Internet Based Tariff Information Systems), UN COMTRADE Database, ITC (International Trade Center), SIAP (from Spanish, *Servicio de Información Agroalimentario y Pesquera*, or Agrifood and Fishing Industry Information Services), and FAO (Food and Agriculture Organization), information was gathered in order to better understand the status of vanilla production at a national and international level. In order to analyze the economic viability of vanilla production in the Santa Beatriz Ranch, the internal rate of return (IRR) was used, which represents the geometric mean of future income expected from an investment. The IRR is defined as the discount rate which makes the present net cash flow rate equal to zero. The equation for IRR is shown below. In this equation *VAN* is the current net value, *I* is the investment, and *Ft* is the cash flow of period *t*.

$$VAN = -I + \sum_{t=1}^{n} \frac{Ft}{(1+TIR)^{t}} = 0 \qquad (1)$$

RESULTS AND DISCUSSION

According to data from the Agrifood and Fishing Industry Information Services, around 58% of the surface of Papantla is dedicated to agriculture, although vanilla only occupies 0.41% of the available surface for farming, which is much lower than the surface devoted to sowing maize (31%), orange (18%), lime (2.2%) and banana (1.8%). The Santa Beatriz Ranch is an agrifood business dedicated to producing vanilla, pepper and citruses, as well as the production of natural vanilla extracts and other natural vanilla products. It should be mentioned that it is the only business in the region devoted to processing vanilla, with more than ten years of experience.

It should be highlighted that one of the most relevant problems brought forth during the interviews is the elevated sales price of sowing vanilla, which stimulates theft and generates insecurity for its sowers. Similarly, it became evident that in Papantla, vanilla is cultivated as a secondary product, since farmers plant it as a tradition, which became clear since from the 100 ha arable in the ranch, only 800 m^2 are used for vanilla.

The description of the supply chain of vanilla production in Santa Beatriz Ranch shows similar elements to other supply chains found when reviewing the literature presented in the second section; however, there are also some distinctive features (Figure 2).

The vanilla production supply chain consists of five links (suppliers, production, transportation, commercialization and the final client).

The link of suppliers includes both those that supply the raw materials —such as fertilizers, insecticides, farming material, cuttings, tutors, etc.— as well as the different sources of financing. It should be mentioned that the producer should have economic solvency since there are very few bank loans for agricultural producers, with high interest rates, although the federal government has implemented different programs such as: Production for Welfare, and the National Program for Fertilizers and Life Sowing, which are focused on the development of small-scale agricultural producers.

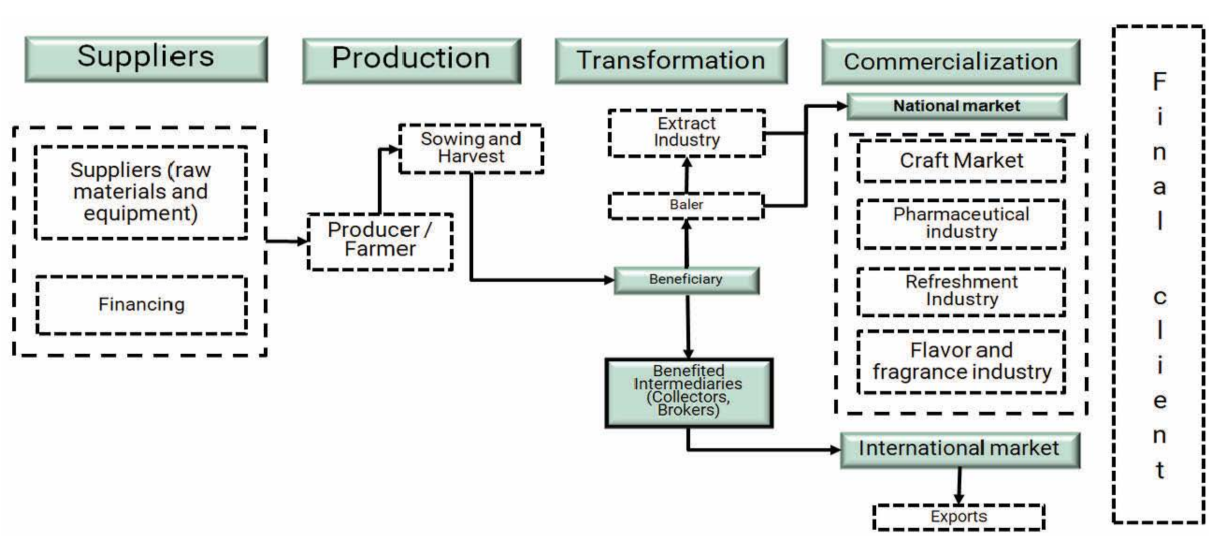

Figure 2. Description of the vanilla supply chain. Prepared by authors.

The link of production includes vanilla sowing and harvesting by the farmers. The starting point for production is the seedling, or cutting, from which the plant develops and afterwards, the fruit. Since vanilla is a climbing orchid, the use of trees or some substitute is necessary, which are called tutors. It is worth mentioning that there is a lack of integration of producers, since each one prompts the sale of cuttings, whose price varies depending on its quality. There are two systems for vanilla production: the traditional system or *acahual* system, which is the most widely used because of its low cost, and the technological system or with use of shade cloth.

In the transformation link there are different processes, the primary one being processing or curing, which lasts two to three months and consists of eliminating water by means of dehydration, oven-cooking and sun-drying. This process includes receiving, scuffing, classifying, placing in wooden crates for sweating, sun-drying, selecting, unloading and packaging. Once this process is finished, the product is sent for transformation where vanilla essence and other natural byproducts are obtained.

The commercialization link entails selling cured vanilla, vanilla extract and handcrafts by means of different local intermediaries, retail and wholesale, which make if possible for the product to reach its final consumer. Intermediaries carry out their activities in local, national and international markets. The national demand for vanilla is 100% covered by national production and its exportation is carried out by agents who service, generally, small and medium scale producers.

The final client link is made up of all the companies that use vanilla in its different presentations. This includes companies that produce different vanilla-based products, such as soft drinks, pharmaceuticals, ice-cream, liquors, wines, essences, lotions, etc.

The economic viability analysis of vanilla production using cash flows that was obtained during the interview process and calculated using the internal rate of return (IRR) of the two production systems (traditional or *acahual* and technological or shade cloth) showed that the time frame for economic viability analysis is ten years. Included in the production cost analysis are labor costs and those generated from farming vanilla for the first time; therefore, first harvest planting costs are taken into account without including funding costs, machinery, or area used for sowing vanilla. These are considered sunk costs, meaning expenditures which have already been incurred, and have already been devalued and used on a previous project and therefore are not relevant for decision making in vanilla farming, in either of the production systems which will be analyzed. However, it should be pointed out that there is an implicit opportunity cost by using those resources.

Table 1 shows the calculation of economic profitability of harvesting approximately 350 kg of vanilla using the tradition or acahual system during ten years. It is to be noted that in order to obtain 1.0 kg of cured vanilla, approximately 6 kg of green vanilla are necessary.

The direct cost of raw materials during the first year increases due to the cost of cuttings which must be used (Table 1). Either way, during the second year direct

Table 1. Return on investment of harvesting 350 kilograms of vanilla under the traditional or acahual production system (units in pesos).

Year	1	2	3	4	5	6	7	8	9	10
Orange	22230	22230	22,230	22,230	22,230	22,230	22,230	22,230	22,230	22,230
Cuttings	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000
Vanilla benefited	-	-	495,000	495,000	495,000	495,000	495,000	495,000	495,000	495,000
Total income	112,231	112,231	607,230	607,230	607,230	607,230	607,230	607,230	607,230	607,230
Direct Labor	144,000	276,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000
Direct Raw Material	36,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000
Direct expenses	19,075	18,045	18,045	18,045	18,045	18,045	18,045	18,045	18,045	18,045
Indirect expenses	15,000	15,0,231	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Total expenses	214,075	315,045	183,045	183,045	183,045	183,045	183,045	183,045	183,045	183,045
Net flow	-101,845	-202,815	424,185	424,185	424,185	424,185	424,185	424,185	424,185	424,185
IRR	103.17%									

Table 2. Return on investment of harvesting 500 kilograms of vanilla under the technical system or shade mesh (units in pesos).

Year	1	2	3	4	5	6	7	8	9	10
Cuttings	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
Vanilla benefited	-	-	825,000	825,000	825,000	825,000	825,000	825,000	825,000	825,000
Total income	120,000	120,000	945,000	945,000	945,000	945,000	945,000	945,000	945,000	945,000
Direct Labor	144,000	276,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000
Direct Raw Material	36,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000
Direct expenses	272,105	18,025	18,025	18,025	18,025	18,025	18,025	18,025	18,025	18,025
Indirect expenses	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Total expenses	467,105	315,025	183,025	183,025	183,025	183,025	183,025	183,025	183,025	183,025
Net flow	-347,105	-195,025	761,975	761,975	761,975	761,975	761,975	761,975	761,975	761,975
IRR	88.99%									

labor costs increase because of pollination which has to be carried out on the crops. It should be mentioned that farmers in this type of system use orange trees as tutors.

During the first two years there is no income since vanilla production dues not start until the third year or depending on agro-climatic conditions until the fourth year; therefore, positive cash flow is not seen until the third year (Table 1). In the traditional or acahual production system there is the added benefit of orange production, which is used as a tutor; therefore, this income is included in the analysis. Likewise, the IRR is 103.17% which means that vanilla farming is profitable, and if sources of funding are available with lower costs than this percentage vanilla production would still be profitable.

Table 2 shows the calculation of the profit margin from harvesting approximately 500 kg of vanilla using the technological or shade cloth production system for ten years, and as shown, the production amount is not the same as that used in the profitability analysis of the traditional or acahual production system (350 kg). This is because the same number of hectares is used in both systems and, therefore, it is possible to compare profitability.

The price of direct raw material increases due to the cuttings used. Likewise, the direct labor costs increase during the second year because of crop pollination. As shown, the direct labor and raw material costs in both production systems are the same. However, the indirect costs are significantly increased during the first year due to the investment required to acquire shade cloth.

During the first two years there is no income from the sale of cured vanilla, since the use of shade cloth does not make the plant ready for production sooner. It is important to highlight that using the technological production system or shade cloth there are no benefits from orange production, since shade cloth is used as a tutor, and therefore this income is not included in cash flow. Still, the IRR is 88.99%, which implies that the technological production system is profitable, even taking into account the financial cost from different sources and it would still be profitable, as long as the cost of financing is less than 88.99%.

When comparing the IRR, both systems are profitable and since they have high sunk production costs they are a good alternative to utilize resources which otherwise could be idle. Nevertheless, if there are alternative projects whose IRR is higher than 88.99%, resources could be used in those projects and vanilla production could be abandoned. Even though cash flows for the technological system are higher by almost 80% when compared to the traditional system, the IRR of the former is lower due to the high cost of shade cloth which has to be acquired in the first year and is not compensated with the increased cash flow after the third year. And even though it is out of the reach of this analysis, the different volumes of production and its inherent complexity should be taken into account, something related to the activities associated with the production systems and additional activities.

CONCLUSIONS

Using the VSM technique, the vanilla supply chain showed that it is made up of five links and it was possible to describe the flow of raw materials and information required in its process, as well s to map out the activities which did or did not generate additional value. The economic profitability of cultivating vanilla using the traditional system reported an IRR of 103.17%, compared with 88.99% with the technological system. Both systems have negative cash flow during the first two years since vanilla cannot normally be harvested until the third or fourth year. The amount of vanilla produced in the technological system is higher (42.85%) than the traditional system, but the latter has the additional product of oranges.

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