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Technological development and its impact on the cost - benefit of avocado production in the Southern Region of the State of Jalisco, Mexico

El desarrollo tecnológico y su impacto en el costo - beneficio de la producción de aguacate en la región sur del estado de Jalisco, México

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Abstract

The objective of this study is to evaluate the technological development through the cost - benefit of the main producers of avocado in Jalisco. Currently, Jalisco has ten municipalities that produced 72.33% of avocado in the period 2014 - 2016. The method was mixed. First, we analyzed the statistical information of the avocado crop; second, application of an open interview to identify the technology used in an orchard that invests in technological development. Subsequently, the costs and sale prices of the avocado were taken in the most efficient region of the state of Michoacán and contrasted with the South, South - East of Jalisco region. The results show that orchards with high technology obtain a higher yield per hectare. Meaning a competitive advantage in costs and a differentiated product. Farmers with production costs of $ 91,500 generate losses. However, there are producers who can maneuver with costs between $ 91,500 to 117,000 per hectare and still earn profits. As long as they have a yield of 10 ton / ha; with a sale price of $ 17,000 per ton. If the price is $ 14,000; will have profits with a yield of 12 tons.

Technological Development, Cost - Benefit, High Technology

Resumen

El objetivo de este estudio es evaluar el desarrollo tecnológico a través del costo – beneficio de los principales productores de aguacate en Jalisco. Actualmente, Jalisco cuenta con diez municipios que produjeron el 72.33% de aguacate en el periodo 2014 – 2016. El método fue mixto. Primero, analizamos la información estadística del cultivo de aguacate; segundo, aplicación de entrevista abierta para identificar la tecnología utilizada en un huerto que invierte en desarrollo tecnológico. Posteriormente, se tomaron los costos y precios de venta del aguacate en la región más eficiente del estado de Michoacán y se contrastó con la región Sur, Sur – Este de Jalisco. Los resultados muestran que los huertos con alta tecnología obtienen un mayor rendimiento por hectárea. Significando una ventaja competitiva en costos y un producto diferenciado. Los agricultores con costos de producción de $ 91,500, generan pérdidas. Sin embargo, hay productores que pueden maniobrar con costos entre $ 91,500 a 117,000 por hectárea y aun así, obtener ganancias. Siempre y cuando, tengan un rendimiento de 10 ton/ha; con un precio de venta de $ 17,000 por tonelada. Si el precio fuera de $14,000; tendrá ganancias con un rendimiento de 12 toneladas.

Desarrollo Tecnológico, Costo – Beneficio, Alta Tecnología

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Introduction

According to the Undersecretary for the Promotion of Agribusiness (SFA: 2011), avocado is a tree native to Mesoamerica, which was already cultivated before the arrival of the Spaniards. The tree can reach a height of 20 meters. However, the ideal one is 5 meters to facilitate the practices of sanitary control, harvest, pruning and fertilization. There are currently 400 varieties in the world, based on their shape and weight. Although it reaches a height of up to 20 meters, for commercialization purposes it does not have a height greater than 5 meters to facilitate harvesting, cultural work and fertilization. Regarding the planting distance of the tree depends on the type of soil and weather conditions, which is 7 to 12 meters from one to the other, allowing to plant from 115 to 180 trees per hectare.

The avocado tree begins to bear fruit from the fifth year, in which up to 50 fruits per tree are obtained; in the sixth year 150 fruits are obtained; in the seventh 300 and in the eighth to 800 fruits per year. From the ninth year the harvest is decreasing.

While the Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA, 2015), who explains that "the avocado is cultivable in areas with an altitude between 1,600 to 2,000 meters above sea level; rain from 1,050 to 1,150 millimeters. As well as a temperature of 15ºC to 19, with permeable and deep soils (sandy loam), without calcareous or chloride and with a pH of 6.0 to 7.5 ". Although, the avocado is a crop that occurs all the year, between the months of March to July 49.1% of the national production is obtained.

On the other hand, Acosta, Hernández and Almeyda (2012) establish that the avocado originates from the mountainous areas of central and eastern Mexico and the upper parts of Guatemala. Currently, they are classified into three races: Mexican (Persea Americana var. Drymifolia); the Guatemalan (P. Americana var. Guatemalensis) and the Antillana (P. Americana var. America); which are recognized from their morphological, physiological and culture characteristics. Commercial avocado varieties are interracial hybrids developed from the exchange of materials between different races.

The most common being Hass, Fuerte, Criollo, Bacón, Gwen and Reed. In the case of Mexico, the Hass variety has the highest demand in the international market. In this sense, Cañas et al (2015: 130-131) argue that all avocado producers should establish suitable processes to select the varieties to be planted to guarantee the continuity of the harvest, lengthen the harvest periods, increase yield, decrease the risks by plagues and diseases, better development of the crop and greater quality of the fruit.

Additionally, they propose that it is better to carry out a grafting of commercial trees of greater acceptance in the market by means of selected seeds of the same orchard, zone or region, on local or Creole patterns that are adaptable to the ecosystem.

Justification

In recent years, agri-food exports from Mexico have grown significantly. Being fruits and vegetables, which contribute significantly in the trade balance. This has been possible due to the technological and compliance with the regulations imposed by the importing countries.

Despite the free trade agreements that Mexico has with other countries, avocado exports are susceptible to a series of tariff impositions as non-tariff, which are used as a protectionist mechanism. In this sense, avocado producers have not been the exception. However, they have created a competitive advantage through technological development in the production of this crop beyond a comparative advantage in terms of climate, soil and water.

Technological development is a source of competitive advantage both in costs and in the differentiation of the product. In this sense, the technology used by avocado producers can be different and varied, depending on the size of the orchards and their capacity to assimilate and transfer technology.

Therefore, the cost advantage is represented by the yield in tons per hectare obtained by each producer. While the differentiation of the product is that it complies with the characteristics or attributes requested by each of the importing countries.

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Problem Statement

In 2016, Mexico made agro-food exports for 29 billion pesos, with avocado being the product that ranked third, after beer and tomato. Likewise, Mexico is considered the first exporter of this fruit, whose main destination is the United States of America (USA), which represented 80% of exports. For example, in the Super Bowl 2017, Mexico exported 100 thousand tons. This figure was 10% higher than in 2016 (El Financiero 06/03/2017). In 2014, the demand for avocado from the USA was covered 65% by Mexico; 23% by the state of California; 7% for Chile and 5% for Peru. What indicates a significant growth of exports in the last two years. It should be noted that Mexico exports to other countries such as: Costa Rica, El Salvador, China, Spain, Germany, United Kingdom, Singapore and Russia (El Financiero 09/16/2014).

The surface planted with avocado in Jalisco, in the year 2017, was 22 thousand hectares, which has represented an average annual growth of 21.3%, in the last 16 years, through irrigation technology, which allowed the production of 120 thousand tons of avocado, of which 62 thousand tons were exported mainly to: Europe, Asia and America (Romo: 2017). On the other hand, the head of the Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA) José Calzada Ruvirosa, said that avocado production in 2012 was 40 thousand tons; while in 2015 it was 119,600 tons, which meant an increase of 299%. Mexico supplies 30% of the global avocado demand for the Hass, Criollo and Fuerte varieties. In 2015, production was one million 644 thousand tons, of which one million 468 thousand tons were exported, that is, 89.9% of national production (El Financiero 06/03/2017).

The main producer of avocado in Mexico is the state of Michoacán that contributed with 78% in 2016. However, the yield per hectare decreased by 20% because the trees produce one year more than in another (alternate tree) , causing an increase in the price. In the case of the price in supermarkets, it ranges from 70 to 80 pesos per kilogram; while in the market supplies the price is 60 pesos per kilogram (Noticias mvs 05/11/2017).

In this regard, Del Moral and Murillo (2016: 4) identified that the average price of avocado in June 2016, at the Central de Abastos of Mexico City from Michoacán was 42 pesos per kilo reaching up to 50 pesos; while the price to the consumer was 57 pesos per kilo. And at the end of the same month, it reached a consumer price of 70 pesos. These increases were due to two factors. The first, avocado production is seasonal. Being the low season in the months of May to August; the second, due to weather aspects such as storm No. 11 and the heavy rains that affect it. As a result, it causes producer shortages and prices tend to rise.

Therefore, we observe that the market price of avocado is determined by the comparative advantage of the regions of Jalisco and Michoacán, defined in terms of climate, water and soil quality. Likewise, other variables such as: production costs, investment, financing, taxes, competition and technology, to name the most important.

However, the market price should be sufficient to cover fixed and variable costs. In this way, the company minimizes losses, but if the price is greater than the costs, the company generates profits. Now, with a price lower than the costs, losses are generated. Thus, the cost advantage is determined by yield in tons for each hectare harvested. The advantage in costs as a result of technological development allows producers a greater margin of financial maneuver in the face of fluctuations in the sale prices of the harvest.

In this way, producers with a cost advantage and product differentiation as a result of technology, allow them a competitive advantage in the international market. In this context, the avocado producers of Jalisco, has not been the exception, since they have intensified their efforts to insert themselves in the global market. Although its foray into the US market has been in vain, due to the obstacles imposed by the Department of Agriculture of that country. According to Rodríguez (2016), in 2016 the Governor of the State of Jalisco announced the authorization by the United States of America for the export of avocado, which would benefit 1,300 avocado producers in twelve municipalities that are recognized as free of avocado pests such as:

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Gómez Farías, Zapotlán el Grande, Sayula, Concepción de Buenos Aires, San Gabriel, Juarez Valley, Mazamitla, La Manzanilla de la Paz, Tapalpa, Zapotiltic, Guadalupe Valley and Arandas.

General objective

Evaluate the technological development through the cost - benefit of the main producers of avocado in Jalisco.

Specific objectives

- Identify the main avocado producers in Jalisco, to determine their contribution to state production.
- Analyze the behavior of the sown area (ha), the production in tons and the sale prices per ton from the period 2010 to 2015.
- Evaluate the cost - benefit of the main producers of avocado in Jalisco, considering the production costs of the most efficient municipalities in the state of Michoacán, given the yield and the price of Jalisco producers.
- The structure of the present study, in addition to this introduction, integrates a review of the theoretical - empirical literature of the avocado, the methods and resources used, the results and the conclusions.

Theoretical Framework

The above coincides with a study conducted by Martínez, Espitia and Valenzo (2013), in which they determine that the comparative advantages of avocado producers in Uruapan, Michoacán, are closely related to natural resources such as: climate, water and quality of the soil, which allows two blooms per year; while countries like Chile and the United States only have one per season. Likewise, they explain that the creation of a competitive advantage should be focused on the technology applicable to the molecular characteristics of the avocado that define and standardize its texture, flavor and color.

Avendaño (2008) argues that despite the comparative advantages that various states have, such as: climate, water availability and cheap labor for fruit and vegetable production, there may be a shift because exports in 2005 had an increase of 2.20%; while in 1993 they increased by 3.23%, which represents a decrease in agrifood exports. The main cause is the saturation of the US market by countries that compete with Mexico such as: Costa Rica, Peru, Guatemala, Ecuador, Chile and China, to name the most important. The competitive advantage of these countries is related to the supply of differentiated products as a result of technological innovation such as: greenhouses, hydroponics or organic. Then, then, Mexico can be displaced because it does not comply with the quality, sanitation and innocuousness demanded by the international market..

The state of Michoacán has been a pioneer in the production of avocado in Mexico, who has exploited its absolute advantage because it is located in a geographical area that allows climatological conditions suitable for cultivation. Placing itself as the first producer and exporter of avocado. Martín (2016), argues that the creation of the competitive advantage of the avocado trees, arose from the year 1914, the year in which the crop was subject to a ban by the United States authorities, alleging that it did not comply with the phytosanitary norms[1].

This fact represented an opportunity that triggered a set of strategies focused on the technological innovation of the region called "Sectorial System of Innovation" (SSI), in whose process of technological learning participated both international and national institutions, the public and private sector. , which promoted the organizational culture, the formation of associations and learning as a key element of SSI such as: basic knowledge[2], the inputs and the existing or potential demand. What meant the elimination of the closure in the nineties. Being the producers of Uruapan, Michoacán, the most benefited by technological innovation

[1]Torres (2009) argues that the ban on avocado imports is caused by the presence of a pest called "screwworm". The trade embargo lasted 83 years until the authorities intervened to ensure the elimination of the pest.

[2] In this regard, Martin (2016) explains that you get from learning processes of each organization, which is not susceptible to being automatically transferred to others, but it is exploited in terms of the capabilities of each company, ie, it is subject to the differentiated and accumulated over time by the organization skills.

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In this regard, Steffen and Echanove (2003) argue that the cultivation of sugarcane was a priority for government authorities due to its high demand from the United States. However, exports were affected because it was displaced by Cuban producers. Later, the sugar cane was destined to the sugar mills installed in the community of San Francisco Peribán[3], of the municipality of Uruapan, Michoacán, which remained until the liberalization of the market, the elimination of subsidies and government support to promote more profitable crops in terms of exports. Therefore, those that were integrated into the production of avocado, from the nineties, had a considerable technological delay, causing inequality in avocado production. On the one hand, there were producers with communal or ejidal lands, which are called "backyard orchards". On the other hand, private gardens with skills in the use and assimilation of technology.

The foregoing, states that although Uruapan is the main producer of the State of Michoacán, there are differences between traditional producers that are limited to the use of fertilizers, chemicals and pesticides versus technological producers that use improved seeds, technical assistance and automated systems. irrigation, among others. The technology induces a marked differentiation of the crop and an advantage in costs because they exploit their economies of scale. Additionally, they have skills in the marketing of the crop through experienced intermediaries. Consequently, technology increases the chances of entering the global market; while others will have to settle for surviving according to the conditions of the domestic market, be subject to coyotaje or yield their land for sale or rent for use by technological producers.

In another context, Torres (2009) explains that the competitiveness of avocados in the US market intensified as producers had mandatory standards[4]. Some of its findings, determines that in the period 1997 to 2004; The relative export advantage (VRE), grew 15.6%. However, this would not have been possible, without the support of the State, who offered all the regulatory and economic facilities to expand the area of avocado cultivation.

In contrast, he argues that although Michoacán is the main producer of avocados nationally and internationally, it is still a maquiladora because marketing is a process still unknown by most avocado farmers. Consequently, the winners of international trade are the trading companies. Therefore, we must work on the implementation and strengthening of a scheme of direct exporters. In this way, the power of setting the differentiated selling price would be eliminated, affecting the less favored in terms of regulations and technology.

In this sense Macías (2010), argues that technological development in the production of avocado in the southern region of the state of Jalisco, has displaced traditional agriculture by a scientific agriculture, which is based on general and standardized procedures that overlook the territorial characteristics. Consequently, the producers generated a high technological dependence to be competitive. Therefore, he expelled those producers without the possibility of investing in technology. On the other hand, the author considers that the production of avocado displaced the cultivation of grains and livestock because the avocado has increased its price due to market conditions. Also, it has caused depletion of territorial resources such as: water, soil and genetic reduction. As well as, health problems due to the use of agrochemicals, labor and social conflicts due to low wages.

Arriaga et al (2013), match Macías (2010), raising one hand that environmental problems is associated with increased cultivation of avocado, especially in damage to forests from deforestation tree in mountainous areas of the state of Mexico. Meanwhile, Steffen and Echanove (2003) explain that in San Francisco Peribán, the authorities allowed the deforestation of pine trees for planting avocado. On the other hand, have been observed phytosanitary problems, such is the case of the state of Mexico, where 77% of the plants come from Michoacan, whose orchards have not a program certified plant, causing the spread of pests.

[3] In some other cases the authorities not only ceded lands, but also allowed the deforestation of pine to grow avocado

[4]The rules applicable to the cultivation of avocados in both production and marketing are: NOM-066-FITO-2002; NOM-016-SCFI-FF-2006 and NOM-128-SCFI-1998, which guaranteed that the product met the phytosanitary enforcement, packaging and marketing, labeling of agricultural produce for domestic or foreign consumption.

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Acosta Hernandez and Almeyda (2012) identified that avocado growers in Nuevo Leon have been affected by the entry of nursery plants Michoacan, without phytosanitary restriction. Therefore, 43% of producers report root diseases such as Phytophthora cinammoni, Verticillium and Armillaria whose phytopathogenic are present in the soil that pollute healthy plants. Also, a minority of contract manufacturers technical support specialists Michoacan state.

As seen, avocado producers in the states of Mexico and Nuevo Leon have a technological dependence. In this sense, Jalisco has been no exception, because there are gardens whose owners are originally from Michoacan, engaged in the same activity. Therefore, they identified an opportunity in Jalisco to extend the planted area, avocado and insecurity that prevails in that state. An advantage to this fact is the technology transfer to the region, but also means to competitive advantage over producers in Jalisco native, who just take a few years in this activity. While Michoacán takes eight years developing technology for growing, which has been transferred to other states.

Methods and Resources

This research focused on two phases which are detailed below:

First phase:

Review of SAGARPA statistics to detect major avocado producing municipalities in the state, based on harvested area. Subsequently, the contribution margin of each was calculated to determine the preponderant role played by each of the municipalities, adding performance tonnes per hectare and the selling price which operated in the market. This period was from 2010 to 2015, because the figures have been stable. Earlier, by 2010 the figures with abrupt changes.

Second stage:

We conducted an in-depth interview to identify the type of technology that uses a representative garden of the state of Jalisco region. Later, he was confronted with the results of a high-tech garden located in the state of Michoacan, in terms of the costs incurred and the selling price.

Thus, Be able to determine the cost - benefit of major avocado growers in the state of Jalisco, based on reference values.

Results

Avocado main producing municipalities in Jalisco

According to a statement from Ing. René Gutiérrez Arenas, director of Trade Promotion Ministry of Rural Development (seder)[5], destacó que en año 2016, Jalisco contaba con 75 municipios productores de aguacate. A este respecto, realizamos un análisis de la producción de aguacate, correspondiente al año 2015. Consideramos, la superficie sembrada por municipio asociada con la producción estatal del aguacate del año en referencia.

The results of the analysis of 2015 showed that the main producers of avocado in Jalisco are: First Zapotlán El Grande with 3,489 ha; San Gabriel second with 2,261 ha; third Farias 1,461 ha., and fourthly Concepción de Buenos Aires 1,459 ha. Total they planted in that year 8,670 ha., Of 19.537 planted in Jalisco, representing 44% of the surface. While 56% of the surface is distributed in the municipalities of Sayula Gordian Tamazula, Tapalpa, Tonila, Tuxpan and Zapotiltic. Likewise, we prepared a map (see Figure No. 1).

According to our findings, the municipality of Zapotlán the Great, is located in a strategic area for the marketing and distribution abroad because most balers, which are estimated to be about thirteen. On the other hand, we identified that the collection of avocado South region - East, is done by packers, who hire staff to cut, pack and move the fruit to stores, in order to reduce product damage. However, a disadvantage with producers in other municipalities is that the avocado is labeled with the brand Zapotlán El Grande, what they perceive as a loss of identity.

[5]http://www.inforural.com.mx/75-municipios-aguacateros-jalisco-segundo-productor-nacional-aguacate/

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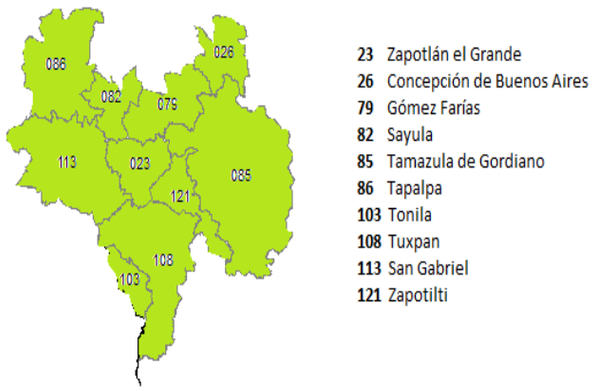

Figure 1 Major avocado producing municipalities in Jalisco
Source: Self Made

On the other hand, Adolfo Aguayo Chavez, manager of Plant Protection Development District 07 of the Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA) argues that Jalisco has 26 municipalities representing 13 thousand hectares of avocado and a production of 100 thousand tons of avocado orchards 1,306 are concentrated mainly in the South Region - South east Jalisco state. Likewise, it determined that 20 of these companies from orchards belong to the state of Michoacan[6], Which are characterized by technological advances in handling the garden, postharvest handling and marketing.

Producing varieties Hass and Hass are Mendez, the difference between the two is due to altitude and climate issues. He also noted that 75% of production is sold on the domestic market and 25% exported to Canada, Japan, the Netherlands, Spain and Belgium. Dull[7](2015), with information provided by Hector Padilla, Secretary of Rural Development who argued that producers of Jalisco are more efficient because planted 600 trees per hectare, which allows for increased performance. While the producers of Michoacan just planting 200-220 trees per ha. He also stressed that according to the Association of Producers and Exporters of Avocado Jalisco (APEAJAL), Jalisco has 15,000 (ha) avocado producing 90,000 tons annually.

Distribution of the area planted

Taking the reference standard of Michoacan avocado producers - Jalisco published by SAGARPA (2014). We identified that there were 313 orchards distributed in the top ten municipalities under study dedicated to the cultivation in Jalisco, which total an area of 9036.82 ha. Table No. 1 shows that in 2014, the municipality Zapotlán El Grande produced 32%; Zapotiltic with 15% and Concepción de Buenos Aires 11%. Orchards these municipalities represent 32% (61); 15% (49) and 11% (93), respectively.

Municipality	Surface Ha	%	No. Huertos	%
Concepción de Buenos Aires.	1,005.60	eleven%	93	30%
Farias	744.90	8%	26	8%
Saint Gabriel	453.55	5%	9	3%
Sayula	942.30	10%	10	3%
Tamazula de Gordiano	246.55	3%	33	eleven%
tapalpa	366.70	4%	5	two%
Tonila	237.80	3%	5	two%
Tuxpan	830.00	9%	22	7%
Zapotiltic	1,358.57	fifteen%	49	16%
Zapotlán El Grande	2,850.85	32%	61	19%
Total	**9,036.82**	100%	**313**	100%

Table 1 Distribution has surface
Source: Based on data from the Register of Producers Michoacan - Jalisco (SAGARPA 2014)

Noting in the municipality of Concepción de Buenos Aires, the largest number of orchards because it has a reduced area ranging from 1 to 5 ha., Which are classified as backyard orchards. On the other hand, the municipalities of San Gabriel, Sayula, Tapalpa and Tonila have fewer orchards, but more extensively hectares. Accordingly, technology must be differentiated between producers. However, it is susceptible marketing both domestically and internationally. The latter must possess characteristics that allow them to be exportable, in accordance with the applicable requirements for each importing country.

[6] Based on information from Ing. Sergio Gómez, the gardener "Los Cerritos" have plantations called "Chilean" which are that each tree is planted at a distance of six meters to three meters. This mode is not allowed to grow so that there is production of high density. Thus, it is intended to make the first production two years of planted trees, which is estimated at 555 trees per hectare and a yield of 200 ton / ha. In the third year it is estimated that each hectare yield seven ton / ha., Up to eleven ton / ha, whose surface is about 800 hectares in different orchards that are in the municipality of Zapotlán the Great. (Diary "The Informer", dated November 12, 2012).

[7] http://eleconomista.com.mx/estados/2014/09/05/jalisco-lidera-productividad-aguacate.

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It is also important to note that the area planted by municipalities under study, in 2014 was 10,393.05 ha (SAGARPA-2014). So there is a surplus of 1356.23 hectares which are not considered in the Register of Producers of Jalisco. It is essential to note that the growing demand for avocados has caused crop planting on uneven terrain. The latter refers to cases of deforestation of pine and oak tree planting avocado. The embodiment is burning and dry tree intentionally to occupy that land. In this regard, both Michoacan and Jalisco have suffered significant environmental damage, which was discussed previously.

In these situations, the Office of Environmental Protection (Profepa) is empowered to close the orchards that operate without the authorization of land use change issued by the Secretariat of Environment and Natural Resources (SEMARNAT)[89]

Technological efficiency

According to the above we conducted an analysis of statistical information of the 10 main producing municipalities in Jalisco and avocado in 2015, accounted for 68% of the area planted. To do this we consider the statistical information available at SAGARPA, the period 2010 to 2015, in order to analyze the following variables: planted area, harvested area, production, yield and average rural price (PMR). The yield per hectare being the variable that determines the technical efficiency of producers and the PMR expressing economic efficiency of avocado producers.

Based on statistics from the Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA), we identified that avocado production from the year 2013 grew by 114% over the previous year; while 2014, 2015 and 2016 grew by 15%, 19% and 20%, respectively.

Additionally, we build efficiency ratios relative to the harvested area tons produced and yield per hectare[10]. The results show that the efficiency of harvested acreage planted was lower than, as seen in Table no. 2. This may be due to natural aspects (drought, flooding, hailstorms); technology (type of planting, irrigation, seeds, fertilizer) and phytosanitary (pests and diseases).

Best rates efficiencies are represented in the years 2014 and 2015; while the lowest are in 2011 and 2012. Although this did not affect the production of avocados, because as we see has had a sustained growth from 2011 to 2016. Since 2013 with a productivity index of 2.14. This is mainly because the yield per hectare was sustained throughout the period under study growth. Consequently, of technological development in avocado production as seed quality, planting techniques, irrigation, fertilizers, pesticides, soil quality and above all weather conditions.

Año	Superficie Sembrada Ha.	Superficie Cosechada Ha.	Índice de Eficiencia Cosecha	Producción (Ton)	Índice de Productividad	Rendimiento Ton/Ha	Índice de Eficiencia Rend.
2011	10,867.98	5,929.35	0.55	37,741.54		6.37	
2012	11,043.11	5,733.60	0.52	40,845.96	1.08	7.12	1.12
2013	13,434.10	8,890.14	0.66	87,367.78	2.14	9.83	1.38
2014	14,976.00	10,827.11	0.72	100,250.33	1.15	9.26	0.94
2015	17,040.85	13,062.65	0.77	119,647.41	1.19	9.16	0.99
2016	19,587.55	13,235.90	0.68	143,504.57	1.20	10.84	1.18

Table 2 Efficiency Index, Productivity and Performance 2011-2016
Source: Prepared with data from SAGARPA.

So the performance is an indicator that expresses the technological efficiency is defined as the ability to produce more with the same resource base, ie without increasing or decreasing the acreage. However, not all producers have at their disposal technology.

[8] According to the newspaper "The Informant" in June 2017 it was closed an area of 12.5 hectares, located in Quitupan, Jalisco, who performed the removal of oak trees for planting avocado.
[9]The General Law on Sustainable Forest Development (LGDES) provides in Article 165, which does not have the authorization from SEMARNAT for change of use of lawful ground, a fine equivalent to 100 shall apply to 20 thousand times measuring unit current. Meanwhile, the Federal Penal Code, Article 418, states impose a sentence of six to nine years in prison. In addition, an amount of 100 to three thousand days of fine (The Informant: June 15, 2017).

[10]It is the result of the area planted between the harvested area. While the productivity and performance index index is the production (ton.), The current year from the figure for the previous year.

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Additionally, avocado orchards must be certified as free of plague[11] and recognized by the National Health Service, Food Safety and Quality (SENASICA) whose surface in Jalisco, in 2016 was 11,958 surface (ha), of the Hass variety. In the case of avocado producers state of Michoacan, representatives[12]Association of Producers and Exporting Packers Avocado of Michoacán (APEAM), stated that 27 municipalities of Michoacan were certified as free of pests and labor export is performed by 38 packing plants, which operate with a high-tech controls the inspection and certification as control mechanisms from food crop planting to packaging. Therefore, Mexico is considered a leader in the automation in the production of avocado efficient management of traceability and product safety above California, Chile, Australia and Peru.

So we see that the automation is relevant to ensure quality product capable of being exported aspect, which means a competitive advantage for avocado growers in the states of Jalisco and Michoacan, whose added value can be in a position to offer the product at a higher price than the competition. If this aspect is valued by exporting countries we should consider that producers have the power to set the selling price to the packing. Therefore, a high demand in the external market, raise prices avocado. Also, remember that just takes a few years Jalisco intensified planting avocado. Therefore, the trees are not in full growth and maturity to bear fruit.

In this regard, the representative of APEAJAL (Ignacio Gomez Arregui)[13]It recognizes that production is lower in the months of March and April, causing shortages because they have to meet deliveries abroad and thus the price increases. In addition in the last two years atypical agro-climatic phenomena affecting some areas in both Jalisco and Michoacan.

Technological capabilities of the South Region - This state of Jalisco

In 2015 we identified that the area harvested was 9,082 (ha), accounting for 53% of the total harvested area. Zapotlán being the city of the Great who garnered 17%. Noting that the harvested area in the other 9 municipalities ranges from 3% to 6%. However, in terms of performance, Zapotlán the Great was 8.30 ton / ha. In contrast, the municipalities of Tamazula, Tonila, Tuxpan and Zapotiltic had an average yield of 12.42 t / ha, which means a difference of 33.17%, among the largest avocado producer. (See Annex No. 1)

The highest rural average price (PMR) was for the municipality of Concepción de Buenos Aires with $ 20,732.50 (ton); Tapalpa was $ 17,357.21 (ton) and Zapotlán Great of $ 13,294.75; while San Gabriel recorded the lowest PMR $ 11,318.82 (ton). So the price difference was $ 9,413.68 (45%). The output value of $ 1202.37 MMDD was (66%), from the value of state of $ 1812.39 MMDD.

By 2014, there were no significant differences in harvested area relative to 2015. While Zapotlán the Great participated with 16% of the state harvest. However, its yield was 8.80 t / ha., Which represents a 15.95% lower compared to the municipalities of Tamazula de Gordian, Tapalpa and Zapotiltic who had an average yield of 10.47 t / ha. Tapalpa being who had the highest PMR $ 18.912 per tonne; while the PMR for Zapotlán Great was $ 12,196.86 per ton., representing 34.42% lower.

The municipality of Concepción de Buenos Aires had the lowest yield with 7.35 t / ha., Accounting for 29.87% lower compared to the most efficient municipalities. Regarding the lowest PMR was $ 8,824.51 per ton, in the town of Farias, representing 53% less compared with Tapalpa. (See Annex 2)

[11]This based on a statement made by the Governed Aristotle Sandoval, in a meeting with the Head of the Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA), José Calzada and Undersecretary for Marketing and Regulatory Programs Department of Agriculture of the United States, Edward Avalos, who also officially announced the export agreement. He also attended the holder of the seder, Hector Padilla, SENASICA authorities, mayors, associations and avocado growers. Press Release State Government on May 27, 2016.http://www.jalisco.gob.mx/es/prensa/noticias/40117.

[12] Héctor Guillén and Jesús Martínez León Castillo, Technical Director and project manager in information technology, respectively. http://www.elfinanciero.com.mx/economia/se-afianza-oro-verde-de-mexico-en-mercado-mundial.html dated September 17, 2014.

[13] Romo, Patricia (2017) M.eleconomista.mx/estados/2017/04/20/exportación-aguacate-causa-escasez-jalisco.

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Therefore, these ten municipalities contribute 48% of the production value state $ 848.014 MMDP. By 2013, we identified that the municipality of Zapotlán the Great contributed 14% of the crop area. However, this year the yield was 25% higher in relation to 2014 and 2015, in which performance has been lower. Performance is closely linked to the technical efficiency, in terms of resource allocation for planting and harvesting of avocado. They had the same behavior as producers in the municipalities of Gomez Farias, Tamazula de Gordiano and Sayula. While performance in the municipality of Tapalpa has been stable.

The lowest yield was obtained by the municipality of Concepción de Buenos Aires 7.06 ton / ha., Which has not had significant changes. In contrast, Zapotlán Great obtained a yield of 11.5 tons / ha., Representing 38.6% above municipality with lower performance. With respect to PMR Gordian Tamazula $ 14,320.83 per ton obtained although only had a yield of 8.75 ton / ha., The lowest was $ 6,863.57, representing a difference of 52%. In the case of Zapotlán Great was $ 11,255.67 in this case was 21%.

Importantly, avocado producers Concepción de Buenos Aires harvested area increased by 27% from 2013 to 2015; although its performance has been maintained. However, if you have gained ground in the PMR, as this increased from 2013 to 2015 at 66.8%, which may reflect a high demand for avocado pressed avocado prices on the rise and not a factor technology to raise product quality, as best production practices would increase the yield per hectare. (See Annex 3).

Another aspect is the contribution of 71% of the value of production, which accounted for $ 630.861 MMDP, was higher than the 2014 and 2015 was 48% and 66% respectively. The area harvested in 2012 was 4189.75 which accounted for 13% statewide, representing just one-third relative to the period 2013 - 2015.

According to information Sagara 2012 (see Annex 4 no.) the municipalities of San Gabriel, Sayula, Tapalpa, Tonila and Zapotitic had a harvested area almost zero, representing a contribution of these 10 municipalities from 13% statewide and thus the contribution of the value of production was just the 22%, representing $ 319, 492 MMDP.

Again Concepción de Buenos Aires had the highest of $ 16,692.22 per ton PMR; while the lowest was $ 6,180.00 for Tapalpa with tonne, whose difference was 62.97%. Regarding the performance ton / ha., The municipalities of Gómez Farías and Sayula was 9.43 and 10 ton / ha., Respectively. While avocado producers Zapotlán the Great was 6.68, ie 36.2% lower than the performance registered in the municipality of Sayula.

Finally, we have the year 2011, the data show that these 10 municipalities contributed just 14% of the harvested area and production value contributed 22% representing $ 258.360 MMDP. It is the municipalities of Gomez Farias and Zapotiltic who had the highest yield per hectare of 9.08 and 9.40, respectively. The lowest yield was for Concepción de Buenos Aires[14]with 6.48 ton / ha, he is representing 31% lower. (See Exhibit 5).

PMR was the largest for the municipalities of Tamazula de Gordiano and Zapotitic of $ 12,348.97 and $ 12,000 per tonne respectively. PMR was the least for the municipality of Tapalpa $ 6,000.00, which means a difference of 51.4%, with reference to the highest price.

Therefore, we identified that the behavior of the most important variables of avocado production in the state of Jalisco, is concentrated in 10 municipalities belonging to the Region 6 South, which are the municipalities of Gomez Farias, San Gabriel , Tamazula de Gordiano, Tonila, Tuxpan, Zapotitic and Zapotlán the Great, of which Tamazula de Gordiano had the highest PMR in 2011, 2013 and 2014. in the Southeast region is only the municipality of Concepción de Buenos Aires who obtained the highest PMR in 2012 and 2015.

[14] We do not consider ton / ha yield., The municipality of San Gabriel because the differences with the other municipalities is significant and bias the central limit information.

Meanwhile, the largest acreage avocado Jalisco, is in the municipality of Zapotlán Great; . While municipalities with a higher yield ton / ha, are: Gómez Farías, Sayula, Tamazula de Gordiano and Zapotiltic. Producers who obtain a higher PMR are: Concepción de Buenos Aires and Tamazula de Gordiano. It should be noted that the producers of Concepción de Buenos Aires, have not significantly increased the area sown, nor ton / ha yield, since the data are constants in the period under study 2010 -. 2015 (see Annex No. 7).

The main producers of avocado are in the municipalities of Tamazula de Gordian, Tapalpa, Zapotiltic and Zapotlán the Great because the results show that increased their crop area and yield ton / ha. Thus, its contribution to the value of the total production that is significant for the performance and PMR.

Evaluation cost - benefit of the leading producers of avocado

To assess profit margins take the avocado production costs in the state of Michoacan, because they are a benchmark to determine under what conditions utilize the resources required for the process of planting and harvesting the fruit, considering the GMF technology[15]specific production and in many cases it can vary by area or region. In this regard,It found significant differences in costs related to technology affecting performance. Such is the case of the municipality of Tacambaro in 1998 were 142% lower than the producers of Uruapan and 92% lower than Tancitaro

In this regard, we consider the different sales prices of the leading producers of avocado in Jalisco. Also, regarding the performance tonnes per hectare. Both have been described and analyzed in the previous section.

Therefore, we performed a sensitivity analysis taking estimating production costs per ton of reference state corresponding to 2016, which have been estimated byTrusts Instituted in Relation to Agriculture (FIRA), the agency considers the cost of production as an indicator that gives certainty to financial intermediaries to provide credit. It also allows easy operations funding services, warranty and technical support. These costs are formulated based on the processes of: planting[16], fertilization[17], Cultural practices[18], Irrigation, pest control[19], Weeds and diseases and various[20].

Considering the costs of likely production sets FIRA 2016, which amounted to $ 91,500.00 per hectare, municipalities with margins positive gain are those with a yield of 7 ton / ha., And a price selling to $ 12,000.00 ton. Both conditions must be submitted. If some municipalities have less than seven ton / ha yield., It is compensated if a price is guaranteed from $ 14,000.00 per ton. This is shown in table no. 3 Taking performance and selling prices reported by SAGARPA 2015[21] (Annex 9).

Municipality	Scenario 1	scenario 2	scenario 3
costs	**$ 91,500.00**	**$ 117,000.00**	**$ 170,000.00**
CBA	$ 61,502.16	$ 35,697.16	- $ 16,997.84
GF	$ 12,532.65	- $ 13,272.35	- $ 65,967.35
SG	$ 3118.48	- $ 22,686.52	- $ 75,381.52
SYL	- $ 391.20	- $ 26,196.20	- $ 78,891.20
TDG	$ 62,234.24	$ 36,429.24	- $ 16,265.76
TPP	$ 82,070.00	$ 56,265.00	$ 3570.00
TON	$ 85,256.16	$ 59,451.16	$ 6756.16
TUX	$ 92,646.04	$ 66,841.04	$ 14,146.04
Zapt.	$ 89,662.50	$ 63,857.50	$ 11,162.50
scaler	$ 18,840.20	- $ 6964.80	- $ 59,659.80

Table 3 Sensitivity Analysis with price and performance by 2015
Source: Prepared with data from SAGARPA and FIRA

Now if we consider costs likely production of $ 117,000 per ha., Estimated by FIRA 2017, we have positive earnings are obtained if higher performance is guaranteed to 7 ton / ha., And a selling price from $ 17357.00 ha. Otherwise losses would unless the yield is 10 tons / ha., And a higher price to $ 12,300.00 per ton.

[15]Mendoza (1998) this technology means: G = gravity irrigation; M = F = with improved and fertilizer use variety. It also establishes that technologies for growing avocados are classified as: BCF, BCS, BMF, BMS, GCF, GCS, GMF, GMS, TCF, TCS, TMF and TMS. Taking the meaning of each abbreviation. B = Irrigation pump, T = Temporal, S = no fertilizer and C = landrace.
[16] Avocado plant.
[17] Application of agricultural chemicals to strengthen the plant, including labor.
[18] technical assistance, pruning, labor, cleaning of crop residues, cajeteo and gasoline.
[19] Herbicide application and tasks.
[20] agricultural insurance, gasoline, maintenance, technical support scheduled record orchard, electricity for irrigation, FEGA guarantee.
[21] See Annex No. 8, 9 and 10

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In Scenario 3, we consider a production cost of $ 170,000.00, according to a producer representative of the municipality of Zapotlán El Grande avocado, because they use a differentiated technology that guarantees a yield per hectare of 20 to 22 ton / ha . However, considering the same sales prices per tonne and yields per hectare, we determined that the minimum yield per hectare must be greater than 10 ton / ha., And a retail price starting at $ 17,000.00. In contrast, increase performance to 12 ton / ha., Priced selling to $ 14,000.00 per ton. Whereas further FIRA estimated a sale price for the period 2017 -. 2018 of $ 15,000 per tonne and a yield of 11 ton / ha, it means that producers would have positive benefits Michoacán.

In the graph no. 1 shows the behavior of profit margins in each of the three scenarios evaluated. Noting that as you increase the yield per hectare utility tends to grow, which is more significant if prices are higher than desirable. Conversely, if performance is less than seven tons per hectare, the price shall be greater than $ 12,000.00 per ton to break even.

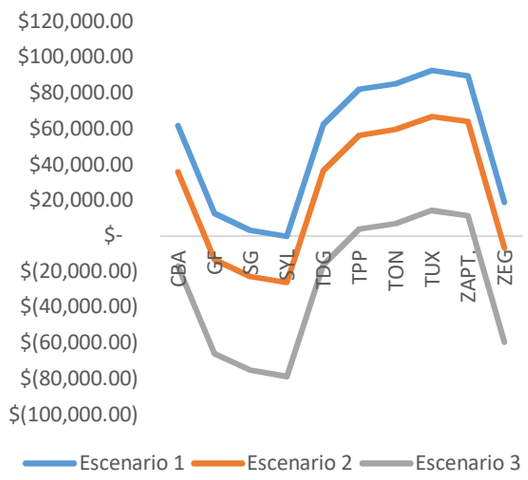

Figure 1 Sensitivity Analysis Utility 2015
Source: Prepared with data from SAGARPA FIRA 2015 and 2016

While in the South - Southeast are concentrated municipalities contributing 53% of state production, the municipalities with the highest profit margin are: Tamazula, Tapalpa, Tonila, Tuxpan and Zapotiltic contributing in 2015 with 17 % of the production. While Zapotlán El Grande contributes with production equals all these municipalities, ie 17%. However, the yield per hectare obtained in 2015, was 8 tons per hectare is above the desirable, but the price is $ 17,357.00 less than, for causing minor benefits.

In contrast, the municipality of Concepción de Buenos Aires has greater benefits because the selling price per ton is $ 20,732.00. Given the above, it should develop strategies aimed at increasing yields greater than 10 tons per hectare because it can withstand prices of $ 12,000.00 per ton and get positive benefits. It is important to note that FIRA, estimated selling prices avocado in 2017-2018, $ 15,000.00 per ton, which absorbs a cost of $ 91,500.00 probable production. However, if they increase to $ 117,000, the yield should be 10 tons per hectare to maximize profits.

Conclusions

Avocado is one of the main crops in the state of Jalisco. This is mainly due to the growth of exports to the United States, Europe and Asia, among others. In response, producers have increased their efforts in development and innovation processes planting - crop harvest to ensure a quality product (size, consistency, flavor), which has been made possible through the use more efficient of inputs used as improved seeds, irrigation systems, certified pest-free culture (screwworm bone) by SENASICA, pesticides, chemical fertilizers and suitable. All this combination increases productivity or yield per hectare fixed land for planting avocado. Consequently, production costs are lower per tonne,

Therefore, technological development raises productivity to meet the increase in aggregate demand, which detonates in the growth and welfare of the region. Some of the significant results show that while, in the state of Jalisco there are 75 municipalities avocado producers. We determined that more than 50% of production is concentrated in ten municipalities. Of these, the first was Zapotlán El Grande (32%); second, Zapotiltic (15%); third, Concepción de Buenos Aires (11%) and fourth Sayula (10%) which accounted for 68% of total production in 2014. However, it will have to take into account the number of gardens in each municipality. For example, in the municipality of Sayula there are more orchards with more land. In contrast, Concepción de Buenos Aires and Zapotlán El Grande, They have a greater number of orchards because there are land called backyard gardens. Therefore, innovation and development must be differentiated for each producer, as with the producers in the state of Michoacan.

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The results showed that despite Zapotlán El Grande is the largest producer, make no profit if the production cost per hectare is more than $ 91,500.00 per ha. While the municipalities of Tamazula de Gordiano and Concepción de Buenos Aires, make profits as long as production costs are in the range of $ 91,500.00 to $ 117,000.00 per ha. In the case of the municipalities of Tapalpa, Tuxpan, Zapotiltic they make extraordinary at any level of production costs earnings, ie in the range of $ 91,500.00 to 170,000.00 ha. Therefore, producers have to establish more efficient production techniques that allow them to obtain a higher yield per hectare. Best practices to increase yield per hectare, thus reducing production costs.

It also must be considered oligopolistic behavior where large avocado producers have the power to set the selling price; while small producers with ejido or communal lands will have to accept the sale price you set the packager who sells and distributes the product, mainly for export. Therefore, the packer is who has control of the value chain avocado.

Valencia and Zetina (2016), suggests that producers are subject to the uncertainty of the change in prices and increased production costs. However, its market share can grow as cultivation offer differentiation, not only in quality but also meet customer expectations in terms of the benefits on health. Therefore, you can increase revenue based on the needs and market requirements.

With regard to employment, high-tech gardens, only hire laborers for the application of chemicals, fertilizers and pesticides. Meanwhile, backyard gardens are the same owners who are responsible for performing all care, whose length ranges from one to five hectares. Balers, hire staff for the lifting of the harvest, in order that the avocado at the time of cutting and hauling suffers minor damage. In both cases, the activities for which contracts are seasonal staff.

Some considerations would carry out a study of the environmental impact has been the state of Jalisco, especially in terms of deforestation of pine and oak forests, depletion of rain wells, soil damage are some problems that we cited earlier .

And it's not like the state of Jalisco, but other states, whose interest is to plant a cash crop due to increased demand in the international market, mainly from the United States, since 80% of the production of avocado Michoacan state is destined to that place and who is at risk by signing the Free Trade Agreement. So the producers of Jalisco must be focused on the opening of other markets beyond the United States.

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Annexes

Municipality	S. Planted (Ha)	%	S. Harvested (Ha)	%	Production (Ton)	Declared Yield (Ton / Ha)	PMR ($ / Ton)
Concepción de Buenos Aires	1,610.00	9%	962.34	6%	7,106.68	7.38	$ 20,732.50
Farias	735.88	4%	665.60	4%	5,689.48	8.55	$ 12,459.82
Saint Gabriel	948.18	6%	830.74	5%	6,941.42	8.36	$ 11,318.82
Sayula	715.21	4%	680.71	4%	4,411.00	6.48	$ 14,060.14
Tamazula de Gordiano	1,022.00	6%	727.00	4%	9,035.50	12.43	$ 12,368.43
tapalpa	682.00	4%	682.00	4%	6,820.00	10.00	$ 17,357.21
Tonila	876.00	5%	506.00	3%	6,125.00	12.18	$ 14,512.70
Tuxpan	881.00	5%	530.00	3%	6,668.00	12.58	$ 14,638.29
Zapotiltic	788.35	5%	577.60	3%	7,220.00	12.50	$ 14,493.88
Zapotlán El Grande	3,402.19	twenty%	2,920.10	17%	24241.02	8.30	$ 13,294.75
Subtotal	11660.81	68%	9,082.09	53%	84258.10		
State	17040.85	100%	13062.65	77%			

Annex 1 Major avocado growers in 2015
Source: Prepared with data from SAGARPA. http://www.oeidrus-jalisco.gob.mx/

Municipality	S. Planted (Ha)	%	S. Harvested (Ha)	%	Production (Ton)	Declared Yield (Ton / Ha)	PMR ($ / Ton)
Concepción de Buenos Aires	1,359.60	9%	897.34	6%	6,591.92	7.35	$ 12,196.86
Farias	578.23	4%	537.95	4%	4,776.93	8.88	$ 8824.51
Saint Gabriel	913.96	6%	478.73	3%	4,356.44	9.10	$ 13,767.72
Sayula	514.76	3%	277.23	two%	2,410.20	8.69	$ 9,500.00
Tamazula de Gordiano	937.00	6%	727.00	5%	7,715.30	10.61	$ 9208.79
tapalpa	682.00	5%	682.00	5%	6,888.20	10.10	$ 18,912.02
Tonila	876.00	6%	334.00	two%	3,109.80	9.31	$ 13,070.70
Tuxpan	832.68	6%	630.70	4%	5,756.96	9.13	$ 13,192.28
Zapotitic	677.60	5%	577.60	4%	6,180.32	10.70	$ 13,722.25
Zapotlán El Grande	3,021.22	twenty%	2,381.12	16%	20953.85	8.80	$ 12,401.70
Subtotal	10393.05	69%	7,523.67	fifty%			
State	14976.00	100%	10827.00	72%			

Annex 2 Major avocado producers in 2014
Source: Prepared with data from SAGARPA. http://www.oeidrus-jalisco.gob.mx/

Municipality	S. Planted (Ha)	%	S. Harvested (Ha)	%	Production (Ton)	Declared Yield (Ton / Ha)	PMR ($ / Ton)
Concepción de Buenos Aires	1,193.00	9%	700.00	5%	4,945.00	7.06	$ 6863.57
Farias	435.61	3%	435.61	3%	4,852.70	11.14	$ 7689.26
Saint Gabriel	558.75	4%	338.35	3%	3,230.09	9.55	$ 8251.37
Sayula	503.61	4%	449.29	3%	4,897.26	10.90	$ 10,912.07
Tamazula de Gordiano	732.00	5%	415.00	3%	3,630.00	8.75	$ 14,320.83
tapalpa	662.40	5%	662.40	5%	7,120.80	10.75	$ 6686.41
Tonila	583.00	4%	390.00	3%	2,925.00	7.50	$ 10,500.00
Tuxpan	1,148.00	9%	787.00	6%	6,689.50	8.50	$ 10,000.00
Zapotitic	837.00	6%	577.00	4%	4,327.50	7.50	$ 10,000.00
Zapotlán El Grande	2,276.49	17%	1,846.69	14%	21236.94	11.50	$ 11,255.67
Subtotal	8,929.86	66%	6,601.34	49%			
State	13434.10	100%	8,890.14	66%			

Annex 3 Major producers of avocado in 2013.
Source: Prepared with data from SAGARPA. http://www.oeidrus-jalisco.gob.mx/

Municipality	S. Planted (Ha)	%	S. Harvested (Ha)	%	Production (Ton)	Declared Yield (Ton / Ha)	PMR ($ / Ton)
Concepción de Buenos Aires	800.00	two%	780.00	two%	5,284.50	6.78	$ 16,692.22
Farias	407.70	one%	302.00	one%	2,847.00	9.43	$ 11,837.20
Saint Gabriel	553.75	two%	112.75	0%	154.00	1.37	$ 9425.66
Sayula	396.26	one%	12.00	0%	120.00	10.00	$ 12,000.00
Tamazula de Gordiano	432.00	one%	185.00	one%	905.50	4.89	$ 11,967.70
tapalpa	453.50	one%	110.00	0%	528.00	4.80	$ 6180.00
Tonila	585.00	two%	76.00	0%	608.00	8.00	$ 7625.00
Tuxpan	456.00	one%	205.00	one%	1,493.50	7.29	$ 8547.33
Zapotitic	566.60	two%	67.00	0%	536.00	8.00	$ 9741.11
Zapotlán El Grande	2,340.00	7%	2,340.00	7%	15624.00	6.68	$ 10,110.60
Subtotal	6,990.81	twenty-one%	4,189.75	13%			
State	33129.33	100%	17200.80	52%			

Annex 4 Major producers of avocado in 2012.
Source: Prepared with data from SAGARPA. http://www.oeidrus-jalisco.gob.mx/

Municipality	S. Planted (Ha)	%	S. Harvested (Ha)	%	Production (Ton)	Declared Yield (Ton / Ha)	PMR ($ / Ton)
Concepción de Buenos Aires	1,008.00	3%	316.00	one%	2,048.40	6.48	$ 10,828.30
Farias	407.70	one%	302.00	one%	2,742.20	9.08	$ 8909.82
Saint Gabriel	553.75	two%	252.75	one%	393.40	1.56	$ 8623.02
Sayula	396.26	one%	12.00	0%	74.40	6.20	$ 9,700.00
Tamazula de Gordiano	432.00	one%	408.00	one%	3,331.20	8.16	$ 12,348.97
tapalpa	453.50	one%	403.50	one%	1,856.10	4.60	$ 6,000.00
Tonila	585.94	two%	354.00	one%	2,378.40	6.72	$ 9983.98
Tuxpan	577.70	two%	360.50	one%	3,242.65	8.99	$ 8539.68
Zapotitic	566.60	two%	283.00	one%	2,660.20	9.40	$ 12,000.00
Zapotlán El Grande	2,340.00	7%	1,800.00	6%	9,000.00	5.00	$ 8,000.00
Subtotal	7,321.45	22%	4,491.75	14%			
State	32603.94	100%	17788.05	55%			

Exhibit 5 Major producers of avocado in 2011.
Source: Prepared with data from SAGARPA. http://www.oeidrus-jalisco.gob.mx/

Municipality	S. Planted (Ha)	%	S. Harvested (Ha)	%	Production (Ton)	Declared Yield (Ton / Ha)	PMR ($ / Ton)
Concepción de Buenos Aires	503.00	two%	316.00	one%	1,834.30	5.00	$ 8396.70
Farias	342.00	one%	302.00	one%	3,766.00	12.47	$ 15,000.00
Saint Gabriel	553.00	two%	553.75	two%	3,901.00	7.04	$ 14,516.92
Sayula	365.00	one%	12.00	0%	132.00	11.03	$ 9499.71
Tamazula de Gordiano	432.00	two%	109.00	0%	736.84	6.76	$ 8311.33
tapalpa	320.00	one%	50.00	0%	55.00	1.10	$ 6,000.00
Tonila	400.00	two%	160.00	one%	2,777.40	17.36	$ 18,000.00
Tuxpan	519.00	two%	177.00	one%	1,810.63	10.23	$ 11,021.23
Zapotitic	314.00	one%	67.00	0%	894.45	13.35	$ 17,500.00
Zapotlán El Grande	2,300.00	9%	1,800.00	7%	9,000.00	5.00	$ 10,000.00
Subtotal	6,048.00	24%	3,546.75	14%			
State	25405.44	100%	12677.49	fifty%			

Annex 6 Major producers of avocado in 2010.
Source: Prepared with data from SAGARPA. http://www.oeidrus-jalisco.gob.mx/

MUNICIPIO	2011			2012			2013			2014			2015		
	Sup. Cosec.	Rend/Ton	PMR/Ton	Sup. Cosec.	Rend/Ton	PMR/Ton	Sup. Cosec.	Rend/Ton	PMR/Ton	Sup. Cosec.	Rend/Ton	PMR/Ton	Sup. Cosec.	Rend/Ton	PMR/Ton
Concepción de Buenos Aires						*$16,692.00*									*$20,732.50*
Gómez Farías		*9.08*			*9.43*			*11.14*							
San Gabriel															
Sayula					*10.00*			*10.90*							
Tamazula de Gordiano			*$12,348.97*						*$14,320.00*		*10.71*	*$18,912.00*		*12.43*	
Tapalpa								*10.75*			*10.10*				
Tonila														*12.18*	
Tuxpan														*12.58*	
Zapotitic		*9.40*									*10.70*			*12.50*	
Zapotlán El Grande	*6%*			*7%*			*14%*	*11.50*		*16%*			*17%*		

Annex No. 7: Main generators value avocado production in Jalisco.
Source: Prepared with data from SAGARPA 2011 to 2015.

Rendimiento ton/ha	PRECIO DE VENTA($/TON)									
	Concepción B.A.	Gómez Farías	San Gabriel	Sayula	Tamazula	Tapalpa	Tonila	Tuxpan	Zapotitic	Zapotlán El Grande
	$ 20,732.00	**$12,459.00**	**$11,318.00**	**$14,060.00**	**$12,368.00**	**$ 17,357.00**	**$14,512.00**	**$14,638.00**	**$14,493.00**	**$ 13,294.00**
7.38	**$ 61,502.16**	$ 447.42	-$ 7,973.16	$12,262.80	-$ 224.16	$ 36,594.66	$15,598.56	$16,528.44	$15,458.34	$ 6,609.72
8.35	$ 81,612.20	**$12,532.65**	$ 3,005.30	$25,901.00	$11,772.80	$ 53,430.95	$29,675.20	$30,727.30	$29,516.55	$ 19,504.90
8.36	$ 81,819.52	$12,657.24	**$ 3,118.48**	$26,041.60	$11,896.48	$ 53,604.52	$29,820.32	$30,873.68	$29,661.48	$ 19,637.84
6.48	$ 42,843.36	$10,765.68	-$18,159.36	**-$ 391.20**	-$11,355.36	$ 20,973.36	$ 2,537.76	$ 3,354.24	$ 2,414.64	-$ 5,354.88
12.43	$ 166,198.76	$63,365.37	$49,182.74	$83,265.80	**$62,234.24**	$ 124,247.51	$88,884.16	$90,450.34	$88,647.99	$ 73,744.42
10.00	$ 115,820.00	$33,090.00	$21,680.00	$49,100.00	$32,180.00	**$ 82,070.00**	$53,620.00	$54,880.00	$53,430.00	$ 41,440.00
12.18	$ 161,015.76	$60,250.62	$46,353.24	$79,750.80	$59,142.24	$ 119,908.26	**$85,256.16**	$86,790.84	$85,024.74	$ 70,420.92
12.58	$ 169,308.56	$65,234.22	$50,880.44	$85,374.80	$64,089.44	$ 126,851.06	$91,060.96	**$92,646.04**	$90,821.94	$ 75,738.52
12.50	$ 167,650.00	$64,237.50	$49,975.00	$84,250.00	$63,100.00	$ 125,462.50	$89,900.00	$91,475.00	**$89,662.50**	$ 74,675.00
8.30	$ 80,575.60	$11,909.70	$ 2,439.40	$25,198.00	$11,154.40	$ 52,563.10	$28,949.60	$29,995.40	$28,791.90	**$ 18,840.20**

Annex No. 8: Sensitivity Analysis 2015 period, considering production costs of $ 91,500 ha.
Source: Prepared with data from SAGARPA FIRA 2015 and 2016.
Note: Figures in bold diagonal represents the profits with sales prices and actual performance of each municipality.

Rendimiento ton/ha	PRECIO DE VENTA($/TON)									
	Concepción Buenos Aires	Gómez Farías	San Gabriel	Sayula	Tamazula	Tapalpa	Tonila	Tuxpan	Zapotitic	Zapotlán El Grande
	$ 20,732.00	**$12,459.00**	**$11,318.00**	**$14,060.00**	**$12,368.00**	**$ 17,357.00**	**$14,512.00**	**$14,638.00**	**$14,493.00**	**$ 13,294.00**
7.38	**$ 35,697.16**	-$25,357.58	-$33,778.16	-$13,542.20	-$26,029.16	$ 10,789.66	$10,206.44	-$ 9,276.56	$10,346.66	-$ 19,195.28
8.35	$ 55,807.20	**-$13,272.35**	-$22,799.70	$ 96.00	-$14,032.20	$ 27,625.95	$ 3,870.20	$ 4,922.30	$ 3,711.55	-$ 6,300.10
8.36	$ 56,014.52	-$13,147.76	**-$ 22,686.52**	$ 236.60	-$13,908.52	$ 27,799.52	$ 4,015.32	$ 5,068.68	$ 3,856.48	-$ 6,167.16
6.48	$ 17,038.36	-$36,570.68	-$43,964.36	**-$26,196.20**	-$37,160.36	-$ 4,831.64	$23,267.24	-$22,450.76	$23,390.36	-$ 31,159.88
12.43	$ 140,398.76	$37,560.37	$23,377.74	$57,460.80	**$36,429.24**	$ 98,442.51	$63,079.16	$64,645.34	$62,842.99	$ 47,939.42
10.00	$ 90,015.00	$ 7,285.00	-$ 4,125.00	$23,295.00	$ 6,375.00	**$ 56,265.00**	$27,815.00	$29,075.00	$27,625.00	$ 15,635.00
12.18	$ 135,210.76	$34,445.62	$20,548.24	$53,945.80	$33,337.24	$ 94,103.26	**$59,451.16**	$60,985.84	$59,219.74	$ 44,615.92
12.58	$ 143,508.56	$39,429.22	$25,075.44	$59,569.80	$38,284.44	$ 101,046.06	$65,255.96	**$66,841.04**	$65,016.94	$ 49,933.52
12.50	$ 141,845.00	$38,432.50	$24,170.00	$58,445.00	$37,295.00	$ 99,657.50	$64,095.00	$65,670.00	**$ 63,857.50**	$ 48,870.00
8.30	$ 54,770.60	-$13,895.30	-$23,365.60	-$ 607.00	-$14,650.60	$ 26,758.10	$ 3,144.60	-$ 4,190.40	$ 2,986.90	**-$ 6,964.80**

Annex No. 9: Sensitivity Analysis 2015 period, considering production costs of $ 117.305 ha.
Source: Prepared with data from SAGARPA FIRA 2015 and 2016.
Note: Figures in bold diagonal represents the profits with sales prices and actual performance of each municipality.

Rendimiento ton/ha	PRECIO DE VENTA($/TON)									
	Concepción Buenos Aires	Gómez Farías	San Gabriel	Sayula	Tamazula	Tapalpa	Tonila	Tuxpan	Zapotitic	Zapotlán El Grande
	$ 20,732.00	**$12,459.00**	**$11,318.00**	**$14,060.00**	**$12,368.00**	**$ 17,357.00**	**$14,512.00**	**$14,638.00**	**$14,493.00**	**$ 13,294.00**
7.38	**-$ 16,997.84**	-$78,052.58	-$86,473.16	-$66,237.20	-$78,724.16	$ 41,905.34	-$62,901.44	-$61,971.56	-$63,041.66	-$ 71,890.28
8.35	$ 3,112.20	**-$65,967.35**	-$75,494.70	-$52,599.00	-$66,727.20	$ 25,069.05	-$48,824.80	-$47,772.70	-$48,983.45	-$ 58,995.10
8.36	$ 3,319.52	-$65,842.76	**-$75,381.52**	-$52,458.40	-$66,603.52	$ 24,895.48	-$48,679.68	-$47,626.32	-$48,838.52	-$ 58,862.16
6.48	-$ 35,656.64	-$89,265.68	-$96,659.36	**-$78,891.20**	-$89,855.36	-$ 57,526.64	-$75,962.24	-$75,145.76	-$76,085.36	-$ 83,854.88
12.43	$ 87,698.76	-$15,134.63	-$29,317.26	$ 4,765.80	**-$16,265.76**	-$ 45,747.51	-$10,384.16	-$11,950.34	-$10,147.99	-$ 4,755.58
10.00	$ 37,320.00	-$45,410.00	-$56,820.00	-$29,400.00	-$46,320.00	**-$ 3,570.00**	-$24,880.00	-$23,620.00	-$25,070.00	-$ 37,060.00
12.18	$ 82,515.76	-$18,249.38	-$32,146.76	$ 1,250.80	-$19,357.76	$ 41,408.26	**-$ 6,756.16**	-$ 8,290.84	-$ 6,524.74	-$ 8,079.08
12.58	$ 90,808.56	-$13,265.78	-$27,619.56	$ 6,874.80	-$14,410.56	$ 48,351.06	-$12,560.96	**-$14,146.04**	-$12,321.94	-$ 2,761.48
12.50	$ 89,150.00	-$14,262.50	-$28,525.00	$ 5,750.00	-$15,400.00	$ 46,962.50	-$11,400.00	-$12,975.00	**-$11,162.50**	-$ 3,825.00
8.30	$ 2,075.60	-$66,590.30	-$76,060.60	-$53,302.00	-$67,345.60	$ 25,936.90	-$49,550.40	-$48,504.60	-$49,708.10	**-$ 59,659.80**

Annex No. 10: Sensitivity Analysis 2015 period, considering production costs of $ 170,000 ha.
Source: Prepared with data from SAGARPA FIRA 2015 and 2016.
Note: Figures in bold diagonal represents the profits with sales prices and actual performance of each municipality.

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