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Artículos Científicos

Análisis económico de productores y comercializadores de nopal en el Valle de Teotihuacán

Economic Analysis of Nopal Production and Marketing in Teotihuacan Valley

Análise econômica de produtores e comerciantes de nopal no vale do Teotihuacán

Blanca Estela Hernández Bonilla
Universidad Autónoma del Estado de México, CU UAEM Valle de Teotihuacán, México.
behernandezb@uaemex.mx
https://orcid.org/0000-0003-0925-7286

Adriana Mercedes Ruiz Reynoso
Universidad Autónoma del Estado de México, CU UAEM Valle de México, México.
amruizr@uaemex.mx
https://orcid.org/0000-0003-4294-2912

Verónica Ramírez Cortés
Universidad Autónoma del Estado de México, CU UAEM Valle de Teotihuacán, México.
vramirezc@uaemex.mx
https://orcid.org/0000-0001-6541-6769

Sendy Janet Sandoval Trujillo
Universidad Autónoma del Estado de México, CU UAEM Valle de Teotihuacán, México.
sjsaldovalt@uaemex.mx
https://orcid.org/0000-0001-6966-7135

Margarita Dávila Hernández
Tecnológico de Estudios Superiores de Coacalco, México.
davilahernandezmargarita@gmail.com
https://orcid.org/0000-0002-2361-9522

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Resumen

Esta investigación se enfoca en el análisis de las condiciones económicas de la producción del nopal en la región en la que se ubica el Centro Universitario UAEM Valle de Teotihuacán. Fue desarrollada por un grupo multidisciplinario de investigadores de las áreas de economía, administración, contabilidad e informática, y comprende siete municipios del Estado de México: Acolman, Axapusco, Nopaltepec, Otumba, San Martín de las Pirámides, Temascalapa y Teotihuacán, donde la agricultura es una de las actividades más relevantes. En este estudio se estimaron las siguientes condiciones: situaciones laborales, proceso productivo, formas de comercialización, relación costo-beneficio y valoración de las hectáreas sembradas contra las cosechadas. Como parte de los resultados, en primera instancia, se pudo establecer que las condiciones laborales de la región son precarias. En ocasiones los productores prefieren dejar el producto en los plantíos a razón del bajo precio que ofrecen los compradores. Además, el nopal tunero está siendo sustituido por el nopal verdura, el cual brinda mayores posibilidades de rendimiento. Por otra parte, las plagas que afectan los plantíos influyen en el desinterés de los productores para implementar nuevas alternativas que generen mejores condiciones de producción, comercialización y utilidades. A través del presente estudio se determinó que se debe de difundir la importancia de estos productos típicos y altamente nutricionales con miras a su preservación. Adicionalmente, se identificó que en la región del Valle de Teotihuacán existen tres asociaciones de comercialización de nopal, tuna y xoconostle que agrupan a un número significativo de productores, las cuales han construido bodegas grandes con apoyo gubernamental con el objetivo de concentrar y comercializar el producto. El Centro Universitario UAEM Valle de Teotihuacán tiene el compromiso social de vincularse con los productores de la región para generar propuestas de solución a las diversas problemáticas identificadas y planteadas.

Palabras clave: beneficio social, comercialización, Estado de México, nopal, producción y distribución, Valle de Teotihuacán, valor nutricional.

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Abstract

This research relates on the analysis of the economic conditions in the production and marketing of prickly pear cactus (*nopal*) at the region of the Centro Universitario UAEM Valle de Teotihuacán. It was developed by a multidisciplinary researcher group in the areas of economics, administration, accounting and information technology, and includes seven municipalities of the Estado de México: Acolman, Axapusco, Nopaltepec, Otumba, San Martín de las Pirámides, Temascalapa and Teotihuacán, where agricultural activity is one of the most important of the region. In this study the following conditions were estimated: labor conditions, production process, marketing methods, cost-benefit ratio and valuation of the hectares cultivated against the harvested obtained. As part of the results, it was established that the labor conditions of the region are precarious. Occasionally, producers prefer to leave the product on the plantations because of the lower prices offered by the buyers. Also, the *nopal tunero* is being replaced by the *nopal vegetable*, which offers greater possibilities of economic performance. On the other hand, plagues often affect the plantations derivatives and have an influence on the disinterest of the producers to invest or suggest new alternatives that can lead to better conditions of production, marketing, utilities and distribution services. As one of the most important economic activities that impact on the growing and development conditions of the region, it is very important to generate conditions to enhance production and distribution to new markets that allow *nopal* producers and the population to improve their standard of living level. So, this study determines the nutritional importance of these products for their preservation of this type of typical food with highly nutritional values. Additionally, it was identified that in the region of the Teotihuacan Valley there are three marketing associations of prickly pear cactus, prickly pear *tunas* and *xoconostle* that bring together a significant number of producers, which have built large cultivated hectares with government support in order to concentrate and market the product. Finally, the Centro Universitario UAEM Valle de Teotihuacán has a social commitment to association with the producers in the region to generate proposals to provide solutions to the various problems that were identified.

Keywords: social benefit, marketing, Estado de México, nopal, production and distribution, Valle de Teotihuacán, nutritional value.

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Resumo

Esta pesquisa enfoca a análise das condições econômicas da produção nopal na região onde está localizado o Centro Universitário UAEM Valle de Teotihuacán. Foi desenvolvido por um grupo multidisciplinar de pesquisadores das áreas de economia, administração, contabilidade e computação, e compreende sete municípios no Estado do México: Acolman, Axapusco, Nopaltepec, Otumba, San Martín de las Pirámides, Temascalapa e Teotihuacán, onde a agricultura É uma das atividades mais relevantes. Neste estudo foram estimadas as seguintes condições: situações de trabalho, processo produtivo, formas de comercialização, relação custo-benefício e valorização dos hectares plantados em relação aos colhidos. Como parte dos resultados, em um primeiro momento, foi estabelecido que as condições de trabalho da região são precárias. Às vezes, os produtores preferem deixar o produto nos campos devido ao baixo preço oferecido pelos compradores. Além disso, o cacto de pera espinhosa está sendo substituído pela pera espinhosa vegetal, que oferece maiores possibilidades de desempenho. Por outro lado, as pragas que afetam as plantações influenciam o desinteresse dos produtores em implementar novas alternativas que gerem melhores condições de produção, comercialização e lucros. Através do presente estudo, determinou-se que a importância desses produtos típicos e altamente nutricionais fosse disseminada com vistas à sua preservação. Além disso, identificou-se que na região do vale de Teotihuacán existem três associações de marketing para pera espinhosa, pera espinhosa e xoconostos que reúnem um número significativo de produtores, que construíram grandes armazéns com apoio do governo para concentrar e comercializar o produto . O Centro Universitário Valle de Teotihuacán, da UAEM, tem um compromisso social de se conectar com os produtores da região para gerar propostas de soluções para os vários problemas identificados e levantados.

Palavras-chave: benefício social, comercialização, Estado do México, pera espinhosa, produção e distribuição, Vale do Teotihuacán, valor nutricional.

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Introduction

Mexico has a wide variety of climates that make possible the cultivation of various food products. Among these products is the nopal. The nopal is a nutritious and cheap food; Furthermore, in recent years, it has been discovered to have medicinal properties. Among the great diversity, the most common are the vegetable prickly pear, forage prickly pear and prickly pear cactus.

In Mexico the number of cactus producers is around 11,000. The effort of these producers has led our country to occupy the first position in production worldwide, with 777,000 tons per year. The most representative states in the production of prickly pear are Mexico City, Morelos, and the State of Mexico (Meet Hidroponía, 2017).

The present study focuses on the nopaleras that are crasicaul scrub (vegetation with a predominance of cacti); These bushes include different species of prickly pear, which vary in structure and composition depending on humidity, temperature, substrate and the use to which they have been subjected. They are also biological communities with a great diversity of microhabitats that provide food and refuge for mammals, reptiles, amphibians, birds and insects (National Commission for the Knowledge and Use of Biodiversity (Conabio, 2014).

The delimitation of the present study covers the Teotihuacán Valley region, specifically it includes seven municipalities where nopal production is carried out: Acolman, Teotihuacán, San Martín de las Pirámides, Otumba, Axapusco, Nopaltepec and Temascalapa, all of them located in the northeastern region of the State of Mexico. According to data from the National Institute of Statistics and Geography [Inegi] (2000), it is a semi-rural region, whose main economic activities are the cultivation of prickly pear, vegetables and prickly pear, and to a lesser extent corn and barley, with a reduced agro-industrial and industrial micro-business sector.

The nopal "product" is highly commercialized in other countries, so it is relevant to create the conditions to potentiate production and commercialization to new markets, actions that allow producers and the population better economic conditions. The premise of this research is that, although the prickly pear cactus is in decline compared to the nopal vegetable derived from the profits generated, it is a priority to ensure the preservation of the production of both products to preserve this typical and highly nutritional food for future generations.

In the Teotihuacán Valley region, there are three marketing associations for prickly pear, prickly pear and xoconostle that group together a significant number of producers, which have built

large warehouses with government support with the aim of concentrating and marketing the product; however, the project so far is not working effectively.

The Autonomous University of the State of Mexico (UAEM), through its UAEM Valle de Teotihuacán University Center, has a social commitment to link up with producers in the region to generate proposals for solutions to the various problems identified and raised and, at the same time, to promote the participation in research activities in the students of the degrees of Accounting and Administrative Computing and, in the long run, the degree through this channel.

Therefore, this research analyzes the economic conditions of the producers and marketers of the nopal in the Teotihuacán Valley region. This implies determining the socioeconomic context of said area, studying the types of prickly pear that are grown in the region and their derivatives, identifying the study variables in the production and marketing of prickly pear, designing and applying the instrument to collect information, analyze the information collected from the instrument, interpret results of the economic conditions of the producers and marketers of the nopal in the Teotihuacán Valley and propose improvement strategies to both groups.

Theoretical framework

The etymology of the nopal's scientific name, Opuntia, comes from Opunte, an ancient Greek city in whose vicinity grew large quantities of sweet figs from which a latex was obtained, which was then used to coagulate milk. Due to their similarity, the prickly pear or “prickly pear” fruits were related to figs, so Opuntia can be defined as ‘a plant that bears fruits similar to figs’ (Galicia et al., 2017). In Spain, they are called prickly pears and their fruits prickly pears, although practically nobody takes advantage of them, since eating prickly pears is rather a Mexican tradition.

The nopal (Opuntia sp.) Is a cactus well known for its abundant presence in the country, although there are around 107 different species in Mexico. According to Aranda (2014): It dominates the arid landscapes of the center and north of the country, where some species reach a "thornyly impressive" size, similar to that of a tree. Underneath that fleshy texture, they have a surprisingly hard skeleton, which, together with their large size, has allowed them to resist frost, fire, and attacks by peasants when trying to eliminate them to prepare land for livestock (see figure one).

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Figura 1. Plantación de nopal en el Estado de México.

Fuente: Coordinadora Nacional de las Fundaciones Produce (Cofupro, 2018).

Prickly pear cactus that has been domesticated most intensely is called tame. The main selection trends in domestication have to do with criteria of utility and tastes of farmers. Thus, for the consumption of nopalitos they look for young and thin leaves, with little slime, fiber and thorn, and which slowly oxidize when cut.

In the prickly pears the large and sweet ones are selected, with abundant and juicy pulp, small and not numerous seeds, thin shell without spines and few peanuts; red predominates, but there are other colors.

According to information from Conabio (2014), which began in the 1950s, commercial plantations for prickly pear and prickly pear came to cover 80,000 hectares, but in the 1980s they suffered a drastic reduction due to pests, susceptibility due to excessive genetic homogeneity and poor choice of soils, as well as external climatic factors. Today there are about 56,000 cultivated hectares, of which 78% are dedicated to prickly pear production, about 20% to nopalito and less than 2% to xoconostle (Conabio, 2014).

The supply and demand of the nopal increase day by day. Both in the utilization of wild populations and in intensive cultivation, calendars and practices of propagation, planting, pruning, fertilization, pest management and harvesting are required that optimize production with methods that do not harm the fresh product and guarantee the adequate maturity of the same. Wild nopaleras currently cover about one and a half million hectares, mainly in the Altiplano and Bajío. Nopalitos,

tunas and xoconostles are collected in them, both for self-consumption and for sale fresh or processed (Conabio, 2014).

Legal framework

As for the wild nopaleras, the General Law of Wildlife and the Official Mexican Norm of Protection to Native Species of Mexico of Wild Flora and Fauna apply. In international marketing, cacti are regulated by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (Conabio, 2014).

Regarding plant genetic resources for agriculture and food, it is becoming increasingly important and is an integral factor for agricultural biodiversity. This resource is essential to promote sustainable development. For this, the Federal Law on Production, Certification and Trade of Seeds (Senate Gazette, 2004). In marketing, the use of distinctive signs is regulated internationally by the Agreements on Intellectual Property Rights and Commerce in the World Trade Organization; and in Mexico, by the Industrial Property Law (WIPO, 2018).

In the orchards or nopaleras of solar, the production obeys, in quantity and variety, to the family consumption and to the sale in the local and regional markets, which makes the prickly pear and its derivatives an important resource for the local populations. Plantation cultivation began in the 1950s and today there are about 60,000 cultivated hectares, of which 78% are dedicated to prickly pear production, about 20% to nopalito and less than 2% to xoconostle (Cometuna, Red Nopal y Conabio 2009).

Socioeconomic context of the region

The State of Mexico is located in the center of the country, it has a territorial area of 22,351 km² and a population of 15,175,862 people, according to the 2010 Inegi Population and Housing Census (2000). According to data from the same institute, the State of Mexico is the federative entity that registers the highest gross domestic product (GDP) in the country. During 2015, it reported 1,436,486.88 pesos, which represented 8.67% of the national economic activity. Among the main economic activities that are carried out are real estate and leasing services, commerce, construction, the mining industry and the manufacture of machinery and equipment (Ministry of Economy, 2015).

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Millán and Pérez (2008) point out that the State of Mexico has had different regionalization classifications over time. For example, the one raised during the government of Arturo Montiel (1999-2005) divided the state into 23 regions; region five, known as the Teotihuacán Valley, was made up of the municipalities of Acolman, Axapusco, Nopaltepec, Otumba, San Martín de las Pirámides, Temascalapa and Teotihuacán, located in the northwestern region of the Mexican territory.

These municipalities have as their main economic activities those of the primary and tertiary sector; in the primary sector agriculture and to a lesser extent livestock, while in the tertiary sector retail trade and services provided by tourism visiting the archaeological zone. The territorial area and population of the municipalities that make up the Teotihuacán Valley region, according to Inegi (2010), are shown in Table 1.

The municipality of Acolman is the most populous, derived from the fact that it borders the urban areas of the municipalities of Ecatepec, Texcoco and Tecámac, which has generated the proliferation of housing complexes in the municipality. The foregoing has resulted in the disappearance of harvest areas, making it the municipality in the region with the fewest hectares planted with prickly pear, only 1.5% of the territory.

Tabla 1. Datos estadísticos de la Región del Valle de Teotihuacán.

Municipio	Superficie (km²)	Población total
Acolman	83.86	136 558
Axapusco	231.37	25 559
Nopaltepec	84	8 895
Otumba	195.72	34 232
San Martín de las Pirámides	67.32	24 851
Temascalapa	164.61	35 987
Teotihuacán	83.18	53 010
Total	**910.06**	**319 092**

Fuente: Elaboración propia con base en Inegi (2010).

Among the agricultural activities that take place in the region, the cultivation and harvest of the prickly pear cactus (tunero and vegetables) stands out. According to data from the Agri-Food and Fisheries Information Service [SIAP] (2016), the State of Mexico occupies the first place in the production of prickly pear cactus nationwide; Zumpango district has the largest planted area. This district, it should be noted, is made up of the municipalities of Acolman, Axapusco, Nopaltepec, Otumba, San Martín de las Pirámides, Temascalapa, Teotihuacán and Tlalnepantla de Baz. Of these, the municipality of San Martín de las Pirámides generates the highest production, followed by Otumba, Nopaltepec, Axapusco and Teotihuacán. Without considering the municipality of Acolman, in the Teotihuacán Valley around 27.5% of the territorial surface is sown with prickly pear, be it vegetables or tunero, which highlights the relevance of the activity in question in the region (SIAP, 2016). For their part, Table 2 shows these statistical data.

It is important to highlight the case of the municipality of San Martín de las Pirámides: 70% of its territory is planted with prickly pear, mainly from Las Tunas, which is why this activity is very important for its inhabitants.

Tabla 2. Superficie sembrada de nopal en los municipios del Valle de Teotihuacán

Municipio	Superficie territorial en (ha)	Superficie sembrada Nopalitos (ha)	Superficie sembrada Tuna (ha)	Total de superficie sembrada Nopal	Superficie territorial sembrada de nopal
Axapusco	23 137	14	3102	3116	13.5 %
Nopaltepec	8 400	0	2890	2890	34.4 %
Otumba	19 572	446	3283	3729	19.1 %
San Martín de las Pirámides	6732	101	4633	4734	70.3 %
Temascalapa	16 461	0	1498	1,498	9.1 %
Teotihuacán	8318	3	1556	1,559	18.7 %
Total	82 620	564	16 962	17 526	27.5 %

Fuente: Elaboración propia con base en SIAP (2016).

Nopal state of the art

The nopal is a cactus native to the American continent. Some 215 species have been detected, of which in Mexico there are 100 species of the genus Opuntia, named for their characteristics, namely: tree, shrub, thorny plant, with branches from the base, hermaphrodite flowers, berry fruit, among others . This plant occupies a preponderant place in Mexican culture, both for its presence in the vegetation and for the number of uses it is given and for being an icon of Mexican identity as part of the national coat of arms: it is on a prickly pear cactus where it poses the eagle, a sign that determined the settlement place of Tenochtitlán, which means 'place of the nopal' or 'tunas on the stone' (Conabio, 2014).

Various authors cited by Galicia et al. (2017) consider that the daily benefits of prickly pear cactus provide health benefits, among some of these are:

- It is a source of manganese and phosphorus in the diet, which contributes to the proper development of bones and keeps the immune system alert.
- It provides digestive fiber, which allows the body to have a feeling of satisfaction and reduces appetite, thus controlling weight and obesity, in addition to contributing to digestion through proper work of the intestine: accelerates the passage of food, favors the Nutrient absorption, helps reduce cellulite and retain fluids.

- It is the source of around 13% of the daily value of minerals required by the body, since it contains calcium, magnesium, sodium, iron and potassium, which helps to eliminate harmful toxins in the body, detoxifying it and supporting the functioning of the liver.
- Due to its content of vitamins A, C, B1, B2 and B3, it helps control diabetes and hyperglycemia, reducing high blood sugar levels, as well as glucose, cholesterol and triglyceride concentrations.

On the other hand, Mandujano, Morales, Herrera, Corona and Juárez (2018) report in their research that the use of prickly pear has antioxidant properties, by reducing the rate of deterioration due to corrosion (oxidation) in AISI 1018, 1045 and 4140 steel samples. exposed to an aqueous mixture of sulfuric acid (H2SO4) with prickly pear extract, with an inhibition efficiency of 95%.

Some of the quality characteristics sought by consumers and established in the official Mexican standard NMX-FF-068-SCFI-2006 (Ministry of Economy, 2015) are: size, freshness, free of rot, whole, well-formed, with coloration, flavor and smell characteristic of the species (Maki et al., 2015).

In Mexico it is found mainly in desert and cold regions. According to data from SIAP (2016), the area planted with prickly pear (includes forage, vegetables and tunero) as of December 2016 at the national level was 77,592 hectares, from which a production of 1,453,895 tons of product was obtained, which that left an income of 3 504 994.23 pesos. It is important to highlight that the majority of the planted area is from cactus from Las Tunas, 47 632 ha, however, the greatest production is obtained from the nopal vegetable, 810 939 tons (see table 3).

Tabla 3. Producción de nopal en México

Nopal	Superficie sembrada (hectáreas)	Superficie cosechada (hectáreas)	Producción (toneladas)	Valor producción (miles de pesos)
Forrajero	17 340	15 623	180 251	80 392.28
Verdura	12 620	12 227	810 939	2 062 714.20
Tuna	47 632	45 399	462 705	1 361 887.75
Totales	77 592	73 249	1 453 895	3 504 994.23

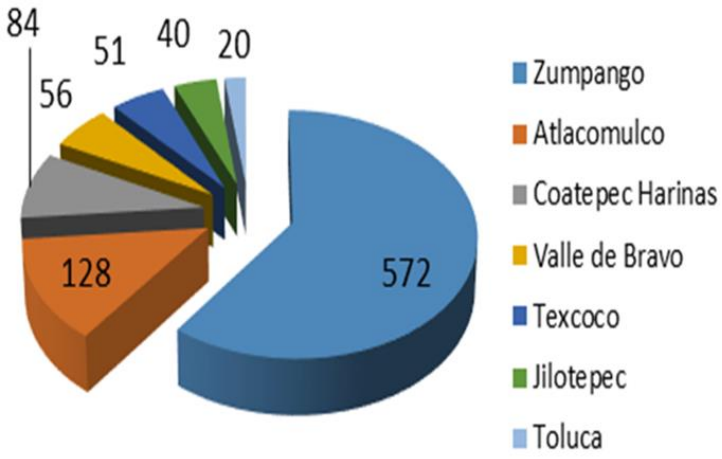
Fuente: Elaboración propia con base en SIAP (2016).

According to the SIAP classification (2016), prickly pear should be understood as forage, that is to say, that which is used as food for animals; As for the nopalitos, there are different types or varieties: the (traditional) vegetable, the greenhouse, macro-tunnel and organic; For its part, the prickly pear can be of the type: alfajayucan, yellow, burron white, crystalline white, Creole, cool pimp, red and xoconostle.

Prickly pear production in the Teotihuacán Valley

In the State of Mexico there are 950 hectares planted with prickly pear cactus in seven districts; The Zumpango district is the one with the highest number of hectares planted, 572 ha, which represents 60% of the production. Figure 2 shows the number of hectares planted in each district. For its part, in figure 3, you can see the number of hectares planted with prickly pear cactus in seven municipalities of the Zumpango district dedicated to it.

Figura 2. Número de hectáreas sembradas de nopal en el Estado de México.



Fuente: Elaboración propia con base en SIAP (2016).

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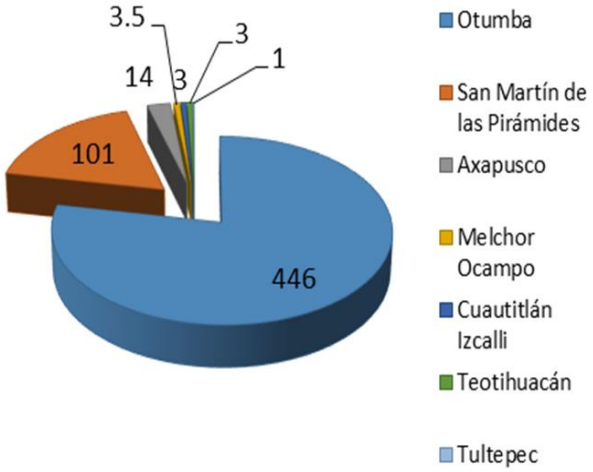
Figura 3. Número de hectáreas sembradas de nopal en el distrito de Zumpango.



Fuente: Elaboración propia con base en SIAP (2016).

As can be seen in figure 3, the municipality of Otumba is the main producer of nopalitos: 78% of the hectares planted with prickly pear cactus are in this municipality, particularly in the town of Cuautlacingo, where they began to change for some 20 years the prickly pear plantations for nopal vegetables (currently all the farmers in the area are dedicated to the production of nopal vegetables). Regarding prickly pear production, the State of Mexico is the main producer with 17,115 hectares. There, production is carried out only in two districts: that of Texcoco and that of Zumpango. In the first, there are only 19 planted hectares; while in the second, 17,096 hectares, most of which are located in the Teotihuacán Valley region, where San Martín de las Pirámides is the main producer, followed by Otumba and Axapusco (see figure 4).

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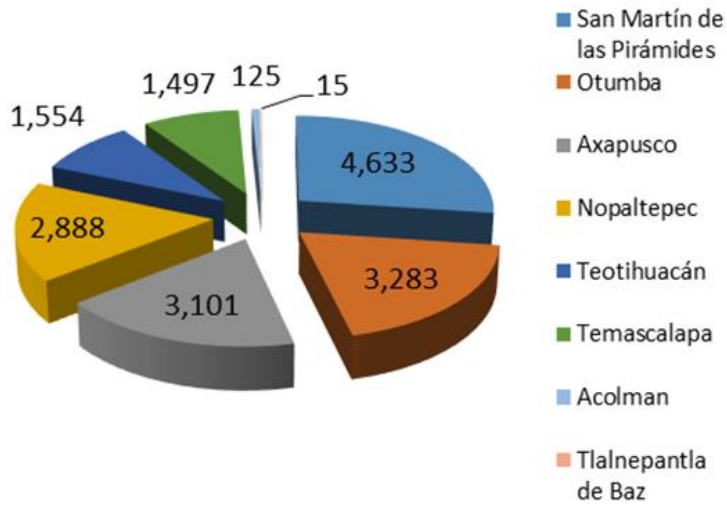
Figura 4. Total de hectáreas sembradas de tuna en el distrito de Zumpango, Estado de México.



Fuente: Elaboración propia con base en SIAP (2016).

The economic spill that leaves the production of both products in the Teotihuacán Valley is 498 769.42 pesos (see table 4).

Tabla 4. Producción de nopal en el Valle de Teotihuacán.

Nopal	**Superficie sembrada (hectáreas)**	**Superficie cosechada (hectáreas)**	**Producción (toneladas)**	**Valor Producción (miles de pesos)**
Verdura	564	564	70 305	70 615.92
Tuna	17 081	17 081	190 275	428 153.50
Totales	17 645	17 645	260 580	498 769.42

Fuente: Elaboración propia con base en SIAP (2016).

An analysis of the data in Table 4 reveals that prickly pear production is the most important in the region, however, the production of prickly pear cactus cannot be ignored, since in an area of around 3% compared with the area planted with prickly pear, it leaves an economic spill of 16% in relation to the latter. Perhaps this is the reason why in recent years some producers have stopped planting prickly pear to plant nopal vegetables.

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Production and marketing

The production of the nopal vegetable is done through two systems: the traditional and the microtunnel or intensive. The traditional one is carried out with the planting of mature leaves and in good condition in rows, with a distance of between 30 or 40 cm between each plant, and around one meter between each row, keeping them at a height of approximately one meter or meter and a half. The micro-tunnel system is carried out under plastic protection placed in the form of corridors, with the aim of protecting the plant from frost and bad weather, in addition to accelerating its heating and production. The leaves are planted with a distance of around 20 cm each and half a meter between each row, and do not exceed one meter in height (Galicia et al., 2017).

On the other hand, the production of the prickly pear cactus is done manually. Through an interview with Mr. Salvador Sandoval Campos, a farmer from the municipality of Teotihuacán, this process was learned. The plant is planted at a distance of between four and five meters, at the moment it is planted, a vine of 50 cm is scratched around and a depth of 30 cm, the soil is stirred with compost, which can be of cattle or chemical, and the stalk that serves as seed is buried.

During the plant's development time, a chemical insecticide, for example Foley, should be fumigated twice a year to prevent or eliminate pests. In addition, the plant must be fertilized at least once a year to promote its growth. The compost serves to heat the soil and the plant, in this way sprouts sprout and the plant develops. Fruit is not harvested until after approximately three years after planting.

Since the plant blooms, around the months of January and February, four months elapse for the development of the fruit. During that period, when the flower begins to sprout, fumigation is required to combat pests. When the fruit begins to cook, the plant is fumigated again to prevent the prickly pear busting during the rainy season. Finally, the harvest arrives around the months of June, July and August.

The harvesting process has peculiar characteristics. Cutters enter the garden around five in the morning with lamps, usually two 18-liter cans, one in each hand; the cutters wear gloves so that, when cutting the fruit, they turn it to the right side several times until it detaches from the stem of the prickly pear, this helps the fruit to not tear, if it is blunted there is a risk that it will be thrown to lose soon (in a period of two or three days), the same happens when you cut the fruit with a hook.

Once cut, the fruit must be cleaned to remove the thorns and remove moisture from the dew. If this process is done manually, it is done in an area away from the orchards, on the outskirts,

called the era, where the fruits are swept with chambray brooms until they are free of thorns. They are then packed in boxes, usually wooden huacales; there is a classification of first, second or third quality depending on the size of the fruit.

Currently, there are de-spining and desking machines that are recommended because they mistreat the fruit less and, as it is done in the shade, its freshness is prolonged. In the Teotihuacán Valley region, there are producers who have acquired this type of machinery and those who do not have it pay to carry out this process (Aguilar, 2003).

In the Teotihuacán Valley, commercialization is carried out in three tianguis in the area, one located in the municipality of San Martín de las Pirámides, another in the municipality of Otumba and one more in the municipality of Nopaltepec. Producers go to these tianguis to sell the fruit, as well as buyers with large trucks, who take the fruit to other places. There the price is in accordance with the supply and demand, normally in wholesale and cash sales. Other producers take their product to nearby supply centers, shopping malls, retail it on the roads or around the archaeological zone, and there are those who export it.

Shared value, the gap to a new business vision

In the current time, entrepreneurs face a paradigm shift, and in order to face it, it is necessary to redefine the purpose of the companies, since their existence and progress depend on it (Porter and Kramer, 2006).

The original model can be completed with the addition of a sixth force that is fundamental and should not be excluded: the public power (Government), which is considered as a factor that analyzes decision-making measures within the industry. It is important to highlight that the creation of value begins with the competitive advantage that may exist. Having a notion about the allocation and use of resources throughout the chain may be the option that allows better performance and greater efficiency.

On the other hand, quality must have a direct impact on cost, customer satisfaction, and product image. The results are not always satisfactory, however, some of these are usually internal to the competitions. The intensity of the competitions depends on the number of active companies that exist, according to the size and their scope. This can be increased in the following aspects, according to the authors Porter and Kramer (2006):

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1) The competitors are numerous and their size must be similar.

2) The growth rate must be variable

3) The configuration of the five forces depends on the intensity, hierarchy and dynamics of the critical factors of success, as shown in figure 5.

For this, not only must you seek personal lucrative benefits, but also, today, society serves as a primary factor for economic development, due to its increasingly demanding and intelligent forms of consumption when buying (Mutis, 2013).

That is why it is required to delve into main concepts such as competitiveness and strategy. According to Porter and Kramer (2006), competitiveness is determined by productivity, defined as the value of the product generated by a unit of work or capital. Productivity depends on the quality of the products (on which the price in turn depends) and on the production efficiency. On the other hand, competitiveness occurs in specific industries and not in all sectors of a country.

Porter (1990, cited in Léon, 2004) was one of the first to structure and systematize a theoretical body around the concept of competitiveness, namely: "The ability to sustain and increase participation in international markets, with a parallel elevation of standard of living of the population. The only solid way to achieve this is based on increasing productivity "(p. 10). Despite the fact that, as noted in the previous definition, Porter includes the human factor as an important element of competitiveness, commonly, when addressing this concept, the need to concomitantly raise the standard of living of the population, an element that constitutes one of the pillars of productivity and, consequently, of competitiveness.

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Figura 5. Conceptos principales como competitividad y estrategia.

Fuente: Porter y Kramer (2006).

Derived from a study focused on successful industries and companies, Michael E. Porter and Mark R. Kramer (2006) made a selection and development of necessary elements for organizations to become competitive, from which they extracted the four sources of competitive advantage, collectively called the diamond of competitiveness (see figure 6).

Porter and Kramer (2006), in their publication Strategy and Society, draw a link between corporate social responsibility (CSR) and competitive advantage, where the principles of the concept of shared value are mentioned, which have an impact on innovation and growth. business. Derived from the above, Porter and Kramer (2006) define business strategy as the deliberate search for an action plan that develops the competitive advantage of a company that achieves growth and expansion of the market by reducing its competition. Shared value, according to Porter and Kramer (2011), establishes methodologies for creating new models and ways of earning money that have as their main interest the current situation in society.

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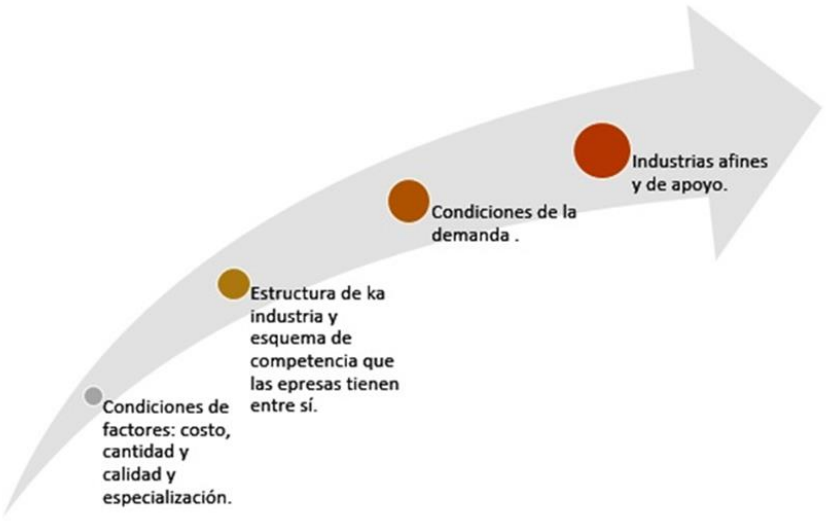
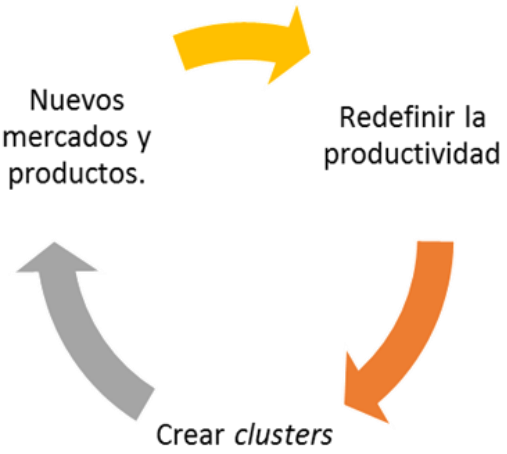
Figura 6. Factores para el diamante de la competitividad.



Fuente: Elaboración propia con base en Porter y Kramer (2006).

According to this same pair of researchers, there are three ways of providing value for the company and for society that make up a cycle in favor of everyone, which can be seen in Figure 7.

Figura 7. Formas para crear valor compartido.



Fuente: Elaboración propia con base en Porter y Kramer (2011).

1) New markets and products. The search for other alternatives that allow to stand out and approach other clients.

2) Redefining productivity in the value chain. To be able to modify activities of the company and its organization as required by demand and the market.

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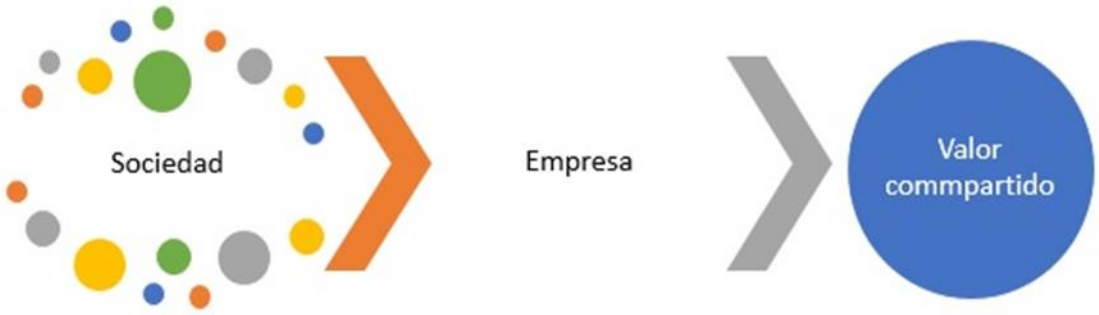
3) Create clusters. They are local support groups for the company to create specific potentials (Porter y Kramer, 2011).

All this to find solutions to social problems with business strategies. Organizations must lead in order to create economic value that contributes to the company itself and to society. That is, for there to be a shared value in business, the factors organized in Figure 8 are required.

Figura 8. Factores principales del valor compartido.



Fuente: Elaboración propia con base en Porter y Kramer (2011).

These factors allow us to work together to create economic value and value for society, addressing both its needs and its challenges. Companies certainly have to merge social progress with business success. To further understand the concept of shared value, Porter and Kramer (2011) mention that leaders and executives should be encouraged to develop new skills and knowledge, with a much deeper vision of what society requires to meet their needs. , in addition to raising awareness of the true bases of productivity of the organization and the ability to collaborate between subjects, whether for profit or not.

A link sector should be the Government; It must regulate laws that allow shared value to be applied, and the best way to do it is by redefining the concept of organization, not considering it only as the creation of profits, this in order to achieve not only growth in the local economy, but in productivity within the global economy to reshape capitalism and its relationship with society.

Porter and Kramer (2011) make it clear that changing objectives and ruling out short-term strategies are the new formula for generating a new alliance between the market and society. And the Government, in addition, can participate with the promotion of support groups where other economic values are incorporated, in order to optimize the main objective of companies and corporations, which is profit with the social good and common good.

The most drastic change for organizations is to recognize themselves as a company with shared social value and a responsible company is one that follows the CSR (Corporate Social Responsibility) model. A company of this second type of CSR is one that renews its decisions so that the actors that surround it are brought together and that goes beyond an economic situation, that is, it is aware in social and environmental aspects, as well as clear finances and measures the impact of their actions periodically.

Regarding these types of responsibilities, they integrate and recognize social and environmental concerns in order to satisfy them and show an approach based on ethical values. While the creation of shared value tries that the companies really commit themselves with the society and, with it, to obtain joint results.

By 2012, different companies worldwide operated RSC model programs. Table 5 lists a few examples of organizations of this type in Mexico.

Tabla 5. Empresas con RSC en México.

Empresa	**RSC** (*Responsabilidad Social Corporativa)*
GRUPO BIMBO	Generar acciones que colaboren energéticamente en los retos venideros de la sociedad.
CEMEX	Comprometido en los momentos difíciles con la sociedad, e interesado en los aspectos sociales y de salud.
COCA-COLA	Contribuye con acciones caritativas, y busca el bienestar individual, social y ambiental.
GRUPO HERDEZ	Empresa que tiene una fortaleza especialmente en las donaciones filantrópicas.

Fuente: Elaboración propia.

These companies are included in this list based on three dimensions, which are economic, social and environmental management. For them, being a CSR company includes more than following an administrative model to the letter. In this sense, it is very important to consider the national position and position, in this case of Mexico. To be able to strengthen oneself, factors such as growth, competitiveness and sustainability are needed, however, the challenge is also cultural, since in many occasions people think so selfishly that they forget about those around them. In this regard, the creation of shared value sets the tone for solving, not all, but some of the problems that companies face in building economic value that contributes business and socially (see figure 9).

In summary, shared value is a possible solution to the distribution of the country's wealth, rethinking its capitalist structure, where the support and development of each industry is equitable

with society, and thus create a bond that impacts not only temporarily, but long-term. Achieving this would avoid social problems and generate opportunities for success, proposing the creation of a unique value in CSR programs but using strategies that locate the social dimension in the general proposal within the organization.

Figura 9. Factores de fortalecimiento en México.

Fuente: Elaboración propia.

Undoubtedly, the prejudices that, from managerial and managerial levels, are held and that prevent facing social issues must be overcome, as well as incorporating profitability in social improvement issues, taking into account that this serves to take the first step in the game of common interests.

General systems theory

General systems theory (TGS) is presented as a systematic and scientific way of approaching and representing reality and, at the same time, as an orientation towards a stimulating practice for transdisciplinary forms of work (Arnold and Osorio, 1998). TGS is an orderly and scientific form of representation of the real world, see figure 10. From its principles it is summarized that it allows an analysis for the solution of problems derived from systems in general, through a global vision. TGS was developed in 1925 by Ludwing Von Bertalanffy (Gutiérrez, 2005).

One of the most outstanding ideas of this theory indicates that it is not enough to analyze an element in isolation, but that it is essential to analyze the element along with the others with which it is related. With this, it is established that the behavior of a system element will affect, to a lesser or greater degree, those elements with which it is related.

The TGS is a set of models, principles and laws valid for any type of system regardless of

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the nature of its elements and the relationships between them (Gutiérrez, 2005). TGS is as important in the construction of a new multidisciplinary project as the application of this approach is necessary in its development. In this section each of its parts is analyzed and how later, when joining them, an integral system is formed. These parts are: the integration of knowledge, specialization in order to reduce time and costs, but, above all, understanding the operation of the whole, the system.

TGS encompasses studies of social systems embedded among other interrelated systems. This approach has a cause and effect relationship, that is, that something is part of something bigger or bigger (Hernández, 2011). Similarly, it is understood that TGS is a tool that allows the explanation of phenomena that occur in reality and also makes it possible to predict the future behavior of that reality through the analysis of the totalities and internal interactions of these and the external ones with their environment. As a scientific paradigm, TGS is characterized by its holistic and integrative perspective, where what matters are the relationships and the sets that emerge from them. As a practice, it offers a suitable environment for fruitful interrelation and communication between specialists and specialties (Arnold y Osorio, 2017).

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Figura 10. Representación gráfica de la teoría general de sistemas (TGS).

Fuente: Elaboración propia con base en Gutiérrez (2005).

Since the subject of TGS is the formulation and derivation of those principles that are valid for all "systems" in general, an example where it is possible to appreciate this is in physics, since this science deals with systems of different levels of generality: it stretches from quite special systems to special laws of physical disciplines, such as mechanics or optics. It would seem, then, that a general theory of systems would be a useful instrument by giving, on the one hand, usable and transferable models between different fields and avoiding, on the other hand, vague analogies that have often hampered progress in these fields (Von Bertalanffy, 1976).

In counterpart, it is stipulated that TGS must be interpreted as a science of systems in the specific sense of doctrine of principles applicable to all systems (or defined subclasses of them). Rigorously developed, it must exhibit an axiomatic structure in which precise definitions and adequate axioms appear, from which a priori deductions are made (Hidalgo, 1978). The TGS, through the analysis of the totalities and the internal interactions of these and the external interactions with their environment, is, nowadays, a powerful tool that allows the explanation of the phenomena that occur in reality, and also makes possible the prediction of the future behavior of that reality.

It is an approach that the scientist must use, since his role, in our opinion, is, precisely, the knowledge and explanation of reality, or a part of it (systems), in relation to the environment that surrounds it, and, on the basis of this knowledge, to be able to predict the behavior of that reality,

given certain variations in the environment or environment in which it is inserted. (Johansen, 1993).

There is another, even more important aspect of TGS. It can be paraphrased by a happy formulation due to the well-known mathematician and founder of information theory, Warren Weaver, by Von Bertalanffy (1976).

> Classical physics, he said, was highly successful in developing the theory of unorganized complexity. For example, the behavior of a gas is the result of the disorganized movements, and impossible to follow in isolation, of innumerable molecules; collectively, it is governed by the laws of thermodynamics. The theory of unorganized complexity is ultimately rooted in the laws of chance and probability and in the second law of thermodynamics. In contrast, the fundamental problem today is that of organized complexity. Concepts such as organization, totality, management, teleology and differentiation are foreign to the usual physics. However, they appear at every step in the biological, behavioral and social sciences, and are truly indispensable to deal with living organisms or social groups. In this way, a fundamental problem posed to modern science is that of a general theory of organization. General systems theory is capable in principle of giving exact definitions of such concepts and, in appropriate cases, of subjecting them to quantitative analysis (Von Bertalanffy, 1976).

System definition

In accordance with TGS, a system is described as a set of elements that interact and have a common objective. Every system is made up of objects or units grouped in such a way that they constitute a logical and functional whole that is greater than the sum of those units.

On the other hand, there are some complementary definitions:

- Part of a universe, with a limited extension in space and time.
- A set of objects related to each other and their attributes.
- It is the structure or organization, where the relationships between its parts are clearly shown.
- It is a set of entities characterized by certain attributes, which have localized relationships with each other in a certain environment, with a certain objective (Trasobares, 2003).
- Another definition of system based on TGS is one that describes it as a set of related parts

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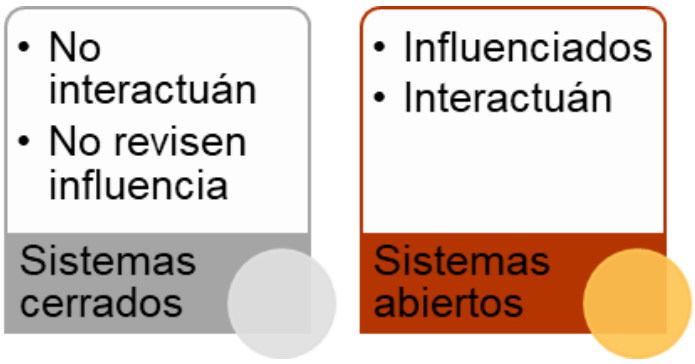
to unify.

The systems are divided into two: closed and open, as illustrated in Figure 11 (Robbins and Coulter, 2010). Additionally, a system is a set of parts that are related to each other so that in the end they come together and perform a certain function.

Figura 11. Representación de tipos de sistemas.



Fuente: Robbins y Coulter (2010).

On the other hand, contrary to the understanding of Robbins and Coulter (2010), who, as we have seen, divide the systems into closed and open, there are other authors who affirm that there is no fully closed or open system, as indicated by Hernández (2011).

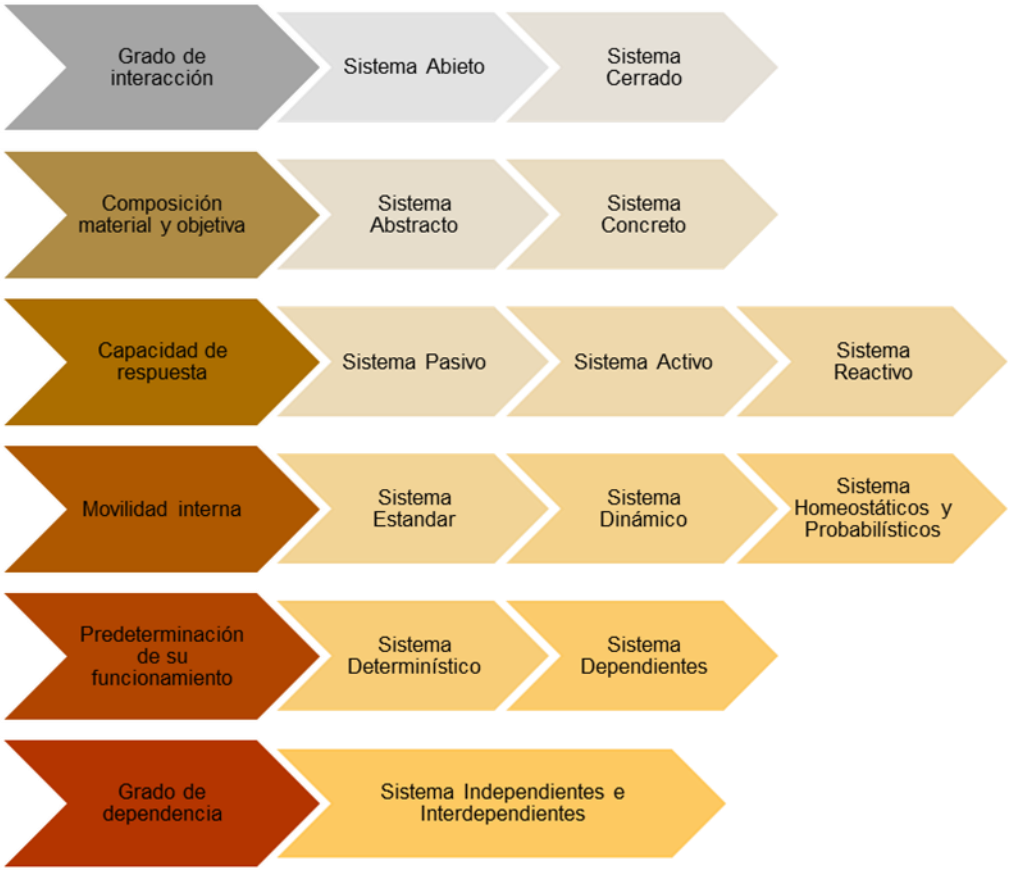
According to Hernández (2011), systems depend on their material composition, the objectives of their elements and their capacity. And they are divided into abstract and concrete, as seen in figure 12.

Figura 12. Tipos de sistemas de acuerdo a Hernández (2011).

Fuente: Hernández (2011)

An abstract system is one that considers elements to be concepts. While a concrete system is one that consists of elements that are objects in their entirety. As we have seen, systems are categorized through various approaches; all, however, serve as analysis tools in multidisciplinary projects. Figure 13 shows the main categorizations.

Figura 13. Clasificación de los sistemas.



Fuente: Hernández (2011).

Regarding the degree of interaction, it is established that there is no completely closed system. A system will always show to a greater or lesser degree the opening that defines it precisely as open. As for its material and objective composition, it is directly related to systems constructed abstractly or from concrete, that is, tangible, objects.

On the other hand, the response capacity is grouped into three different options: the anticipation of the response in reactive systems, the response to an action in active systems and, finally, the passivity expressed as that which corresponds to the lack of response to external stimuli. A system that shows some internal mobility will be defined, in turn, from three possible categories: standard, dynamic and homeostatic. Similarly, systems can be categorized by their operation as deterministic or independent. Finally, relating the degree of dependency with other systems, they are categorized as dependent or independent to a greater or lesser extent.

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Methodology

This research is based on the qualitative method, with an intentional and arbitrary sample of 150 subjects related to the production and marketing of prickly pear and prickly pear in the Teotihuacán Valley. In addition, it is cross-sectional: it was carried out during the period 2017-2018.

Rodríguez, Gil and García (1996) define that the qualitative research approach studies reality in its natural context, as it happens, trying to make sense of, or interpret phenomena according to the meanings they have for the people involved. Qualitative research involves the use and collection of a wide variety of materials, among which the interview, personal experience, life stories, observations, historical texts, images, sounds stand out. All of the above describe routine and problematic situations and meanings in people's lives.

Furthermore, it has a strong emphasis on exploring the nature of a specific social phenomenon, based on a hypothesis about it. Also, a tendency to work with structured and unstructured data; It is investigated in a small number of cases, and the analysis of data implies the interpretation of the meanings and functions of human actions, expressing it through descriptions and verbal explanations, statistical analysis acquiring a secondary plane.

The research design is established through structured interviews with 40 items; These consist of a series of questions by blocks related to the categories of production, working conditions, market, among others.

Therefore, the process and phases of qualitative research and research design places the researcher in the empirical world and determines the activities that he will have to carry out in order to achieve the proposed objective.

Furthermore, qualitative research establishes that competent and qualified observers can report objectively, clearly and precisely about their own observations of the social world, as well as the experiences of others.

The four fundamental phases in the project's qualitative research process are, according to Rodríguez et al. (1996), the following:

1) preparatory,
2) field work,
3) analytical and
4) informative.

Results and Discussion

The main objective of this research is the academic link with the productive sector of the Teotihuacán Valley region through an analysis of the economic conditions of the nopal producers and marketers. Thus, information is collected based on labor conditions, production process, ways of commercialization, the cost-benefit ratio and the valuation of the coverage of the planted hectares against the harvested ones. This study focused on seven municipalities dedicated to the production of prickly pear in the State of Mexico: Acolman, Axapusco, Nopaltepec, Otumba, San Martín De Las Pirámides, Temascalapa and Teotihuacán. These are located in the northeast region of the State of Mexico.

It is worth mentioning that this research was developed by a multidisciplinary group; Its members are researchers from the areas of economics, administration, accounting and computing attached to the UAEM Valle Teotihuacán and Valle de México University Center.

Thus, taking into account the social commitment of the UAEM Valle de Teotihuacán University Center, the academic link with the productive sector is considered transcendental. Derived from the research carried out, this project corresponds to the Line of Generation and Application of Knowledge (LGAC) of Accounting and Financial Administration in the Company, as part of the strengthening of the academic body Accounting-Financial Administration of the UAEM Valle de Teotihuacán University Center and of the academic body Computer Science and Technology in Organizations of the UAEM Valle de México University Center.

The strength of the research is the active participation of the highly trained and ideal human resource for the generation of applied knowledge and the possibility of delving further into the economic conditions of the producers and marketers of the prickly pear cactus in the Teotihuacán Valley region and its surroundings. .

The research indicated in its results that the cultivation of prickly pear is essential for producers in this area, as it is one of the most important economic activities that impacts the growth and development conditions of the region. This product is commercialized in Mexico and other countries, so it is of utmost importance to create conditions to potentiate production and commercialization towards new markets, which allows producers and the population to improve their standard of living.

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Among the most relevant results of the research are the following:

- It is identified that the production of the prickly pear is seasonal and that it depends on this that the production is used to the maximum, which has a direct impact on the producers.
- One of the main problems in the cultivation of prickly pear and prickly pear is the cochineal pest, which generates a deformation in the fruit and is very difficult to eradicate.
- The prickly pear plant is replaced by nopal vegetable because the latter is cultivated all year round and, therefore, generates more income for the producer.
- The working conditions of the workers are precarious because they lack social security, a fixed salary, since they receive piecework and do not have healthy conditions.
- The workers are hired on a temporary basis and come mainly from the states of Puebla, Tlaxcala, Hidalgo, Veracruz and Oaxaca.
- There are producers and marketers who monopolize the collection of the smallest producers and set low prices.
- In accordance with the law of supply and demand, when there is a good harvest, the sale price becomes cheaper, which affects producers because costs increase in relation to profit.

It should be noted that the working conditions in the region were identified as precarious. In this line, the producers behave with a certain apathy and prefer to leave the lost product in the fields due to the low price that the buyers offer. On the other hand, pests and / or fumigating agents severely affect plantations. This influences the disinterest of producers to implement new alternatives that generate better conditions of production, marketing and profits. It is also identified that the production of the prickly pear is only by season, which causes some producers and marketers to monopolize the excessive collection of the smallest producers, thereby establishing low purchase prices, but high sales. Finally, this project has as a priority to incentivize and train producers to obtain a better benefit, since most of them engaged in cultivation are elderly and have relatively limited studies, while the new generations of young people do not The activity of the cultivation of the prickly pear is interesting to them because of the minimal or no profits obtained.

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Conclusions

The Teotihuacán Valley region is identified as an agricultural production area for prickly pear, greengrocer and xoconostle, however, the incentives to increase production are almost nil. An identified problem is that producers do not consider a period with abundant harvest beneficial, since, due to excessive demand for the product, prices become cheaper than production costs, to the extent that it is not profitable for producers. .

The product life cycle is very short in the three products contemplated here. And although a small percentage of producers produce nopal derivatives, jam, sweet and pickled, are the main products, the rest of the producers consider that the lack of capital for infrastructure and the lack of knowledge to undertake nopal derivatives are limiting, which results in a lack of incentives to take advantage of the harvest, sometimes even prefer not to harvest it.

Another factor limiting its expansion in the market is that only 10% of producers are registered with the Ministry of Finance and Public Credit (SHCP); the rest sell their production to intermediaries at low prices, with no sales options and no possibility of obtaining benefits through government programs for agricultural activities.

It is a priority to promote the field through policies oriented and focused on profitable activities. One option that needs to be considered is to protect the national agro-industry; Nopal products produced in other countries are observed in the national market. Incentivizing and training producers is important, since most of them are elderly and young people do not find the activity attractive because of the minimal or no profits they make.

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Rol de Contribución	Autor (es)
Conceptualización	**Blanca Estela Hernández Bonilla**
Metodología	**Blanca Estela Hernández Bonilla**
Software	**NO HAY CONTRIBUCIÓN**
Validación	**Blanca Estela Hernández Bonilla** (principal) **Adriana Mercedes Ruiz Reynoso** (que apoya)
Análisis Formal	**Blanca Estela Hernández Bonilla** (principal) **Verónica Ramírez Cortés** (que apoya) **Sendy Janet Sandoval Trujillo** (que apoya) **Margarita Dávila Hernández** (que apoya) **Adriana Mercedes Ruiz Reynoso** (que apoya)
Investigación	**Verónica Ramírez Cortés** (principal) **Sendy Janet Sandoval Trujillo** (que apoya) **Margarita Dávila Hernández** (que apoya)
Recursos	**Blanca Estela Hernández Bonilla**

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Curación de datos	**Adriana Mercedes Ruiz Reynoso**
Escritura - Preparación del borrador original	**Adriana Mercedes Ruiz Reynoso**
Escritura - Revisión y edición	**Adriana Mercedes Ruiz Reynoso** (principal) **Blanca Estela Hernández Bonilla** (que apoya)
Visualización	**Adriana Mercedes Ruiz Reynoso** (principal) **Blanca Estela Hernández Bonilla** (que apoya)
Supervisión	**Adriana Mercedes Ruiz Reynoso** (principal) **Blanca Estela Hernández Bonilla** (que apoya)
Administración de Proyectos	**Adriana Mercedes Ruiz Reynoso** (que apoya) **Blanca Estela Hernández Bonilla** (principal)
Adquisición de fondos	**Blanca Estela Hernández Bonilla**