

# The Mango Value Network (*Mangifera indica* L.) in Campeche, Mexico

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## ABSTRACT

**Objective:** To characterize the mango value network in the state of Campeche and identify its challenges.

**Design/Methodology/Scope:** Based on secondary information and 40 semi-structured interviews, the structure of the value network structure, its key actors and technology was identified.

**Results:** Researches recommend a high-density plantation of 3,333 plants ha<sup>-1</sup>, although producers seek to increase from 69 to 278 plants ha<sup>-1</sup> only. Generating new production technologies for major cultivars such as Tommy Atkins, Manila and Criollo are required; their vegetative vigor responds differently to local humidity, rain and soil conditions due to their monoembryonic or polyembryonic origin.

**Study Limitations/Implications:** Producers in the social sector do not keep accounting and production records. An estimate of mango yields, investment, income and profits was obtained based on the opinion of producers from the social and business sector of Campeche.

**Findings/Conclusions:** Mango producers in the social sector are willing to grow their orchards with 278 plants ha<sup>-1</sup>; the production technologies of the Tommy Atkins, Manila and Criollo mango cultivars are required and production costs should be estimated. Private sector producers choose to convert mango crops to Persian lime in high plantation density; they deem it to be a priority to address the handling of the fruit fly and its marketing.

**Keywords:** crop handling, high-density plantations, vegetative vigor.

## INTRODUCTION

**Mexico** is the main exporter of mango (*Mangifera indica* L.) in the international market (FAOSTAT, 2020). From 2006 to 2015, the state of Campeche held the 10th position nationwide in average production of mango with 35 994 t, with an average performance of  $14.1 \text{ t ha}^{-1}$ , above the average national yield ( $9.2 \text{ t ha}^{-1}$ ) (SIAP, 2016), and similar to  $14.3 \text{ t ha}^{-1}$  of the leading state, Guerrero. The production has been stable despite having an average annual growth rate (AAGR) of  $-0.8\%$ . The main grown variety is Tommy Atkins (87.4%), followed by Manila (7.1%) and Criollo (6.1%) mango. From 2006 to 2015, the average harvest of Tommy Atkins mango was 33,734 t and accounted for 93.7% of the state production (SIAP, 2016). According to INIFAP (2012), Campeche has 180 564 ha with productive potential for mango, 62% of which had a high potential. In 2013, Colegio de Postgraduados (COLPOS) Campeche Campus promoted the laying down of mango demonstration lands in its "Champotón" Priority Attention Microregion, located on Carretera Haltunchén-Edzná Champotón, Campeche, where producer visits were received and high-density mango handling courses were given. Also, together with the Department of Rural Development (SDR) of Campeche and the PRODUCE Campeche Foundation (FUFROCAM), the mango production in the demonstration module located in Cayal, Campeche was boosted. Nevertheless, mango production and marketing systems that prevail in the state of Campeche, and the bond that there is among different participant actors were not known. For this, the research objective was to characterize the mango value network in the state of Campeche and identify its issue.

## MATERIALS AND METHODS

The research was performed in two stages. The Value Network methodology that was used allowed analyzing the organization of a specialized productive system in a common activity, with the territorial concentration of its economic actors and other institutions, with the development of economic and non-economic nature bonds for the creation of richness, both for their members and territory (Nalebuff & Brandenburger, 2005; Muñoz, 2010). The value network is integrated, at its core, by the actor recognized as the spot of economic activity. On the vertical axis, customers appear on the upper part. They will purchase the produce produced at the center of the network. Also, suppliers appear on the lower part. They will provide all inputs necessary for production. On

the horizontal axis, on the left part, complementors that contribute to improve the product for the client appear. On the right side, competitors contribute to make the product less attractive for our clients.

The first research phase was performed from March to August 2016; 20 key actors were interviewed as they were known inside the network as knowledge-bearers and leaders in their activity. Also, information on the plantation environment, agronomic handling and mango marketing was obtained. In the second phase executed from May to June 2018, 20 additional key actors were interviewed and they were asked about the marketing and issues of the mango value network. In both stages, SADER (Ministry of Agriculture and Rural Development), Department of Rural Development (SDR) of Campeche, the PRODUCE Campeche Foundation (FUPROCAM) collaborators and researchers of the National Forestry, Agricultural and Livestock Research Institute (INIFAP) and COLPOS in the state were interviewed. As for the productive part, the non-governmental representative of the Mango Product System in the state, together with the private and social sector producers of the municipality of Campeche, Tenabo, Champotón and Escárcega were interviewed. The social sector is defined by the set of organizations that do not depend on the public sector and which are outside the private sector and includes ejido owners, agricultural communities and some small agricultural owners (Alfaro *et al.*, 2009).

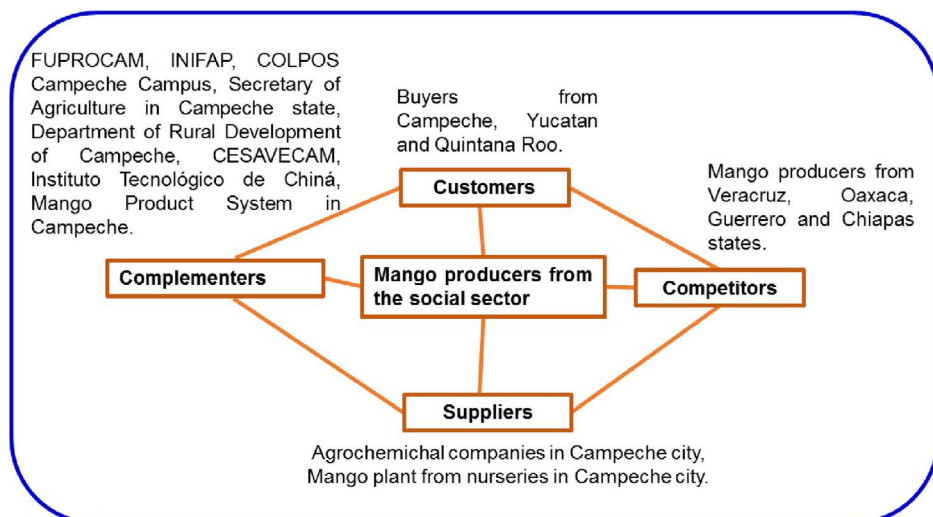
## RESULTS AND DISCUSSION

With the information obtained in the interviews, the identification and structuring of two mango value networks in Campeche was possible. The first one is located in the social sector and the second one in the private sector, which has a more entrepreneurial-oriented vision.

### Mango Value Network in the Social Sector

Producers are at the center of this value network (Figure 1). Orchards are handled traditionally; limited innovations have been adopted in some of these and this allows observing different production levels. Also, it is common to find mango trees in community yards.

Mango orchards are characterized as they have a low growing density, minimum agronomic handling and limited application of fertilizers and fungicides. The quality of the fruit handled this way is better than the one obtained in orchards with no agronomic handling and



**Figure 1.** Mango Value Network in the Social Sector in Campeche, Mexico. Source: Self preparation, with field information gathered from 2016-2018.

the income derived from the sale of fruit is not regular. Orchards are established in soils classified traditionally as type K'ANCAB (honey red land) or "Chromic Luvisol" in the FAO-UNESCO Classification. Other orchards are on YA'AX HOM-type soils (fertile land with vegetation, i.e. "Eutric and dystric Vertisol"), and in AK'AL CHE (lowland flooded land, i.e. "Molic and Eutric Gleysol"). Trees grown in AK'AL CHE soils have a limited growth and they do not require maintenance trimming. Producers have incorporated both the trimming and removal of brushes after the harvest, followed by the application of  $\text{KNO}_3$  for the floral-fructification advance induction and a fertilization with 3 kg of triple-17 plants<sup>-1</sup>. In 2018, the municipalities of Campeche, Tenabo, Champotón and Escárcega recorded an average yield of 13.2 t ha<sup>-1</sup> for the Tommy Atkins cultivar, with an average investment of MX\$18,400.00 ha<sup>-1</sup>, an estimated income of MX\$37,000.00 ha<sup>-1</sup>, and an income of MX\$14,800.00 ha<sup>-1</sup>; nevertheless, improving this income is possible. Since 10 years ago, a producer advances blossoming and produces mango in February, when the price is high (MX\$300.00 per 30-kg box). After the courses given by FUPROCAM-COLPOS to grow mango in high density (3,333 plants ha<sup>-1</sup>) and guided visits to the high-density plantation of COLPOS, Campeche Campus, located at carretera Haltuchen-Edzná, km 17.5, mango producers have implemented some practices in their lands. To induce an advance blossoming, it is common that producers select mango branches based on the amount of present mature shoots, from 5 to 7 months of age in order to spray them with 4 to 6% potassium nitrate ( $\text{KNO}_3$ ) via foliage. Also, formation trimming after the harvest in May have been adopted and they have

increased their mean plantation density in their parcels upon increasing from 69 to 278 plants ha<sup>-1</sup>. Nevertheless, producers do not accept high-density planting; they are concerned about the trunk not being at the posed distance after some years. In comparison with the traditional culture handling, each agronomic practice is performed on specific dates to favor or inhibit the physiologic process of the tree (Vázquez-Valdivia et al., 2009). Also, the social sector producer does not implement quality processes and is unaware of Best Practices for

Agriculture (BPA), which would allow them to obtain fruit for the export market (EMEX, 2016).

Mango value network customers are intermediaries and purchasers from the states of Yucatán and Quintana Roo, who purchase its fresh form, addressed preferably to tourist consumption; also, there are local purchasers from Ciudad del Carmen, Campeche, who bring this to oil rigs. The producer contacts the middleperson through a cell phone, who in turn handles the mango cutting at the orchard. Should the producer harvest, he is responsible for the quality characteristics demanded by the purchaser; should size and color not match the purchaser's request, the price decreases. The fruit offered in town also affects the price because of the competition that exists to sell the product, which is utilized by middlepersons, who speculate with a lower price.

Mango value network competitors in Campeche are producers and sellers in states where mango matching the harvest time is grown, such as Veracruz, Oaxaca, Guerrero and Chiapas. Another actor that takes part in this value network is constituted by input suppliers in agrochemical stores. These companies do not provide credit for producers and only get a payment for the immediate sale of their goods; on occasion, some mango producer families organize to perform consolidated purchases. As for the plant for the establishment of orchards, it comes from local nurseries. Producers take part in training courses and the horizontal transmission of experiences among them for the technical handling of crops.

As a result of the activity of mango value network complementors, a bond between producers with COLPOS has been achieved through demonstrative activities organized by FUPROCAM, SDR and COLPOS itself. Research institutions such as INIFAP, CESAVECAM and Instituto Tecnológico de Chiná do not take part in the resolution of state issues of mango value network and the timely disclosure of results. INIFAP (2013), however, may offer growing production technologies, such as high-density plantation orchards with varieties adapted to the Campeche agroclimatic conditions. In Nayarit, INIFAP showed that, with trimming, the application of paclobutrazol (PBZ) and blossoming inducers, it is possible to control the size of trees and obtain advance harvests with Ataulfo mango (Vázquez-Valdivia *et al.*, 2009). In Sinaloa, INIFAP's results indicate that the Fabián and Palmer cultivars have a post-harvest competitive quality (Siller-Cepeda *et al.*, 2009). In Campeche, FUPROCAM has promoted the plantation of mango

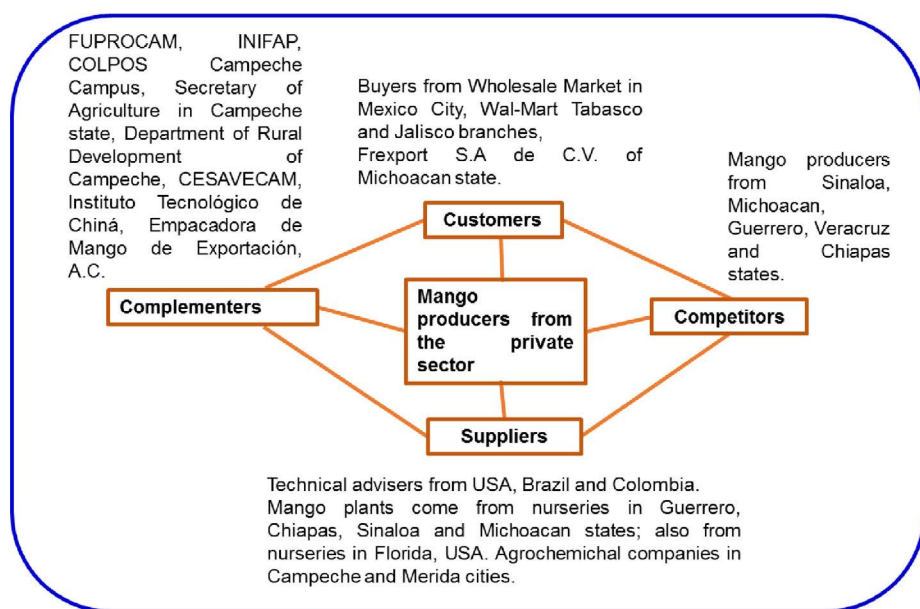
in high density; nevertheless, SDR personnel indicate that it is more crucial to find the more adequate date for produce sales. For the Mango Product System Committee in Campeche, the main problem lies in the withdrawal of financial supports for the growing of mango aimed at the social sector.

### Mango Value Network in the Private Sector

Mango producers in the private sector are the core of the network (Figure 2), they handle their orchards with production technology provided by technicians from the United States, Brazil or Colombia; or they have applied technology that works in other states of Mexico with weather similar to Campeche.

Orchards are established in K'ANCAB soils (chromic Luvisol). Pruning and thinning out after the harvest, the application of KNO<sub>3</sub> so as to advance blossoming, the application of paclobutrazol (PBZ) to regulate growth and production of ethylene so as to homogenize the

yellow color of fruit demanded in the market stand out in the handling of the orchard. These producers mention that the Campeche climate allows the plant to have a rapid and exuberant vegetation growth; nevertheless, these characteristics do not always correspond to a high production level. Producers do not perform the handling of mango orchards in high-density growth, as they consider that the vegetative vigor attained by the mango plant under the Campeche climate conditions does not favor the high-density growth handling technique, reason why they choose to reconvert mango plantations to Persian lime in high-density growth. To this respect, Avilán *et al.* (2007) mention that the trimming type and its periodicity is to be adjusted to the vegetative vigor of the cultivar. Therefore, it is important to consider the excessive vegetative development that characterizes monoembryonic cultivars in the tropic, as it negatively affects the blossoming process and, consequently, the plant's productivity (Avilán *et al.*, 2005).



**Figure 2.** Mango Value Network in the Private Sector in Campeche, Mexico. Source: Self preparation, with field information gathered from 2016-2018.

Entrepreneurial producers sustain that the business key is to advance blossoming to harvest before the Pacific states (Sinaloa, Michoacán, Guerrero), and market the fruit at the Wholesale Market of Mexico City (CA-CDMX). Also, obtaining a fruit fly-free zone certification to access the United States or Europe markets via air freight is vital. Fruit flies (*Anastrepha* spp.) (Dipera: Tephritidae) are the main plague that affects fruit-growing activity in Campeche and that restrict their marketing (Tucuch-Cauich *et al.*, 2008). The annual average production of producers interviewed in the municipalities of Campeche, Tenabo, Champotón and Escárcega

was of 22.5 t ha<sup>-1</sup>, with an investment of MX\$19,422.00, an income of MX\$72,000.00 and profit of MX\$52,578.00. These values are above those obtained by producers from the social sector. Private sector producers have noticed a decrease in blossoming accounting to 20% and they attribute this factor to climate change; also, they consider that the Keith and Haden late varieties are those that better adapt to the Yucatán Peninsula.

The private sector network customers in Campeche are purchasers coming from Mexico City, Wholesale Markets and Wal-Mart Tabasco and Jalisco branches, as well as Frexport S. A. de C. V., a Michoacán-based company. The export quality standards demanded by Wal-Mart stand out. Some producers in this sector have exported mango to the United Kingdom and France via air freight. Nevertheless, producers underline the importance of a strict phytosanitary control of flies in the state that allows them to efficiently market mango in both domestic and foreign markets.

Private sector mango plant suppliers are diverse; the plant may come from plant nurseries in the states of Michoacán, Sinaloa, Guerrero and Chiapas and even Florida, USA. Buds used for grafting come from nurseries in Campeche, Chiapas or Michoacán. Agrochemicals are purchased from companies based in Campeche. However, some producers purchase in Mérida, Yucatán, where they find greater diversity of products, including inputs for organic crops.

Complementors actors are experts in tropical fruit-growing from research institutions such as INIFAP and Tecnológico de Chiná in the state of Campeche. As competitors, mango producers from Sinaloa, Michoacán, Guerrero, Veracruz and Chiapas are recognized; in Sinaloa, fruit with export quality is produced, as they have favorable weather conditions and good soil quality (Siller-Cepeda et al., 2009). Also, the mango price for the national market is set there.

## CONCLUSIONS

Mango production in Campeche is made in two contrasting production systems carried out by social and private sector producers, with scarce bonds between sectors in agronomic and marketing handling processes; they comprise differentiated value networks with particular challenges and they define how they will face them with their own means. It is required that adequate production technologies for the most

important mango cultivars be generated, depending on their monoembryonic or polyembryonic origin that takes advantage of humidity, rain, and type of local soil. No high-density mango commercial orchards have been established in Campeche, as both social and private sector producers have not been convinced about this technology yet. Those in the social sector are willing to work with medium-density orchards (278 plants ha<sup>-1</sup>), while those of the private sector do not consider this technology to be an alternative for mango growth in the state. It is necessary to assess production technologies available in Tommy Atkins, Manila and Criollo mango cultivars, as well as estimating production costs and profitability margins for this crop at different growth densities in producer orchards.

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