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# Economic Dynamics of Ataulfo Mango in Southern Chiapas, Mexico: A Value Network Analysis

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**ABSTRACT:** Ataulfo is a mango variety with unique organoleptic characteristics that is highly appreciated by consumers. The production and marketing of this mango variety in the Soconusco and Istmo-Costa regions are vital components of the agricultural economy of southern Chiapas, Mexico. However, little is known about the participating actors and their interactions, and about the problems that affect this socio-environmental system. To analyze the value network of Ataulfo mango in these regions, various actors were presented with a questionnaire containing questions about social, economic, and environmental aspects of the production and marketing of mango. In total, 133 Ataulfo mango producers and 17 stakeholders were interviewed between January 2020 and February 2022. It was found that the economic forces operating in the Ataulfo mango value network of these regions form a complex but functional network of producers, customers, suppliers, complementors, and competitors, whose activities and services are vital to further the improvement of the production, processing, and distribution of mango. According to the interviewees, problems persist in pest and disease control, prune practices, harvest labor supply, infrastructure, finance and insurance, and in the providing of technical advice and support to producers. Holistic and coordinated solutions are suggested to increase the productivity and sustainability of the Ataulfo mango socio-environmental system in southern Chiapas.

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**KEYWORDS:** stakeholders, production chains, agricultural inputs, market access, commerce analysis.

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## INTRODUCTION

The production of Ataulfo mango is a crucial component of the agricultural economy of Southern Chiapas, Mexico. The Soconusco and Istmo-Costa regions are planted with 29104 and 2925 ha of Ataulfo mango trees, respectively, which corresponds to 97% of the Ataulfo mango-planted area in Chiapas and 48% in Mexico (SIAP, 2022). Ataulfo is a mango cultivar with unique organoleptic characteristics – color, texture, flavor – that are highly appreciated by consumers (Crespo Organic, 2022).

The production and marketing of Ataulfo mango involves a wide range of inputs, from nursery planting to soil analysis, application of agrochemicals, use of agricultural tools and machinery, and harvesting and packaging materials. Also, various suppliers offer specialized services to mango producers, such as fertilization, pest and disease control, and technical audits to ensure compliance with harvest regulations and phytosanitary standards (Aparicio & Diaz, 2015; Ruiz-Díaz & Muñoz-Rodríguez, 2016).

However, smallholders often have poor access to these production improvement services (Ruiz-Díaz & Muñoz-Rodríguez). They also have limited access to new better-yielding mango varieties that are promoted by government institutions (Avendaño-Arrazate & Palacio-Martínez, 2019). On the contrary, mango packing houses and traders have access to a wide range of services, which enables them them to guarantee the quality of the fruit and which facilitates compliance with supply chain market standards (Astudillo-Miller et al., 2020; Maya-Ambía et al., 2011).

Chiapan mango destined for export to the United States, Canada, and Japan has to comply with strict phytosanitary standards in the orchards and other specific regulations, and - if required - be subjected to hydrothermal treatment. Failure to meet these standards could have direct consequences for the region's economy, including loss of access to important export markets (Astudillo-Miller et

al., 2020; Maya-Ambía et al., 2011).

To improve smallholder access to available inputs, services, and market information, it will first be necessary to gain a detailed understanding of the production chain (Zamora, 2016). Eventually, this information will also help to avoid fruit export sanctions. Therefore, the objective of the present study was to analyze the value network of Ataulfo mango production in the Soconusco and Istmo-Costa regions. This study conducted interviews and analyzed the value network, focusing on identifying i) the inputs, supplier services, and processes of the system production chain; ii) the participating actors and their functioning in the value network; and iii) the opportunities and challenges in the production of Ataulfo mango.

## MATERIALS AND METHODS

### Study area

The study was conducted in the Soconusco and Istmo-Costa regions of the State of Chiapas, Mexico. These regions are located at 15°19' N and 92°44' W, jointly covering 4,605.4 km². In Soconusco, Ataulfo mango is produced in the following 14 municipalities: Acacoyagua, Acapetahua, Escuintla, Frontera Hidalgo, Huehuetán, Huixtla, Mazatán, Metapa, Suchiate, Tapachula, Tuxtla Chico, Tuzantán, Unión Juárez and Villa Comaltitlán. In the Istmo-Costa region, Ataulfo mango is produced in two municipalities: Mapastepec and Pijijiapan (SIAP, 2022).

The average annual temperature in the study region ranges between 22.50 and 28.5 °C, with the maximum temperature ranging between 33.0 to 34.5 ºC. The average annual rainfall is 2650 mm (Escalante-Sandoval & Amores-Rovelo, 2014).

The study region is connected to a network of trade routes over land (road to Mexico City, Tuxtla Gutiérrez (capital of Chiapas), and Guatemala (Central America)), over sea (Puerto Chiapas, a coastal deep-sea port on the Pacific Ocean), and in the air (Tapachula International Airport) (Gobierno de Chiapas, 2019).

### Interviews

Between January 2020 and February 2022, 133 Ataulfo mango producers and 17 stakeholders were interviewed. These included input suppliers, consultants, government agents, academics from educational institutions, agricultural association presidents, and mango traders. The questions were asked following a holistic approach (Barrera 2020). The questionnaire included questions of a social, economic, and environmental nature, and was designed to improve our understanding the actors and processes involved in the production and marketing of Ataulfo mango. Questions covered the whole production process (from tree planting to fruit purchase). Interviewees were asked about their perceptions and activities, used inputs, and the range of available services and advice. Also, the orchards were visited to confirm some of the responses, such as the use of machinery and irrigation systems.

### Value network analysis

Data collected from the interviewees was used to explore the value network of the production and marketing of Ataulfo mango following the methodology of Brandenburger and Nalebuff (1997), which analyzes relationships between the different actors based on Porter's five forces model (Porter, 1980).

## RESULTS AND DISCUSSION

The actors in the Ataulfo mango value network in the study regions were identified as producers, customers, suppliers, complementors, and competitors, following Porter´s five forces model (1980) and the actor cooperation model synthesized by Nalebuff and Brandenburger (1996) (Figure 1).

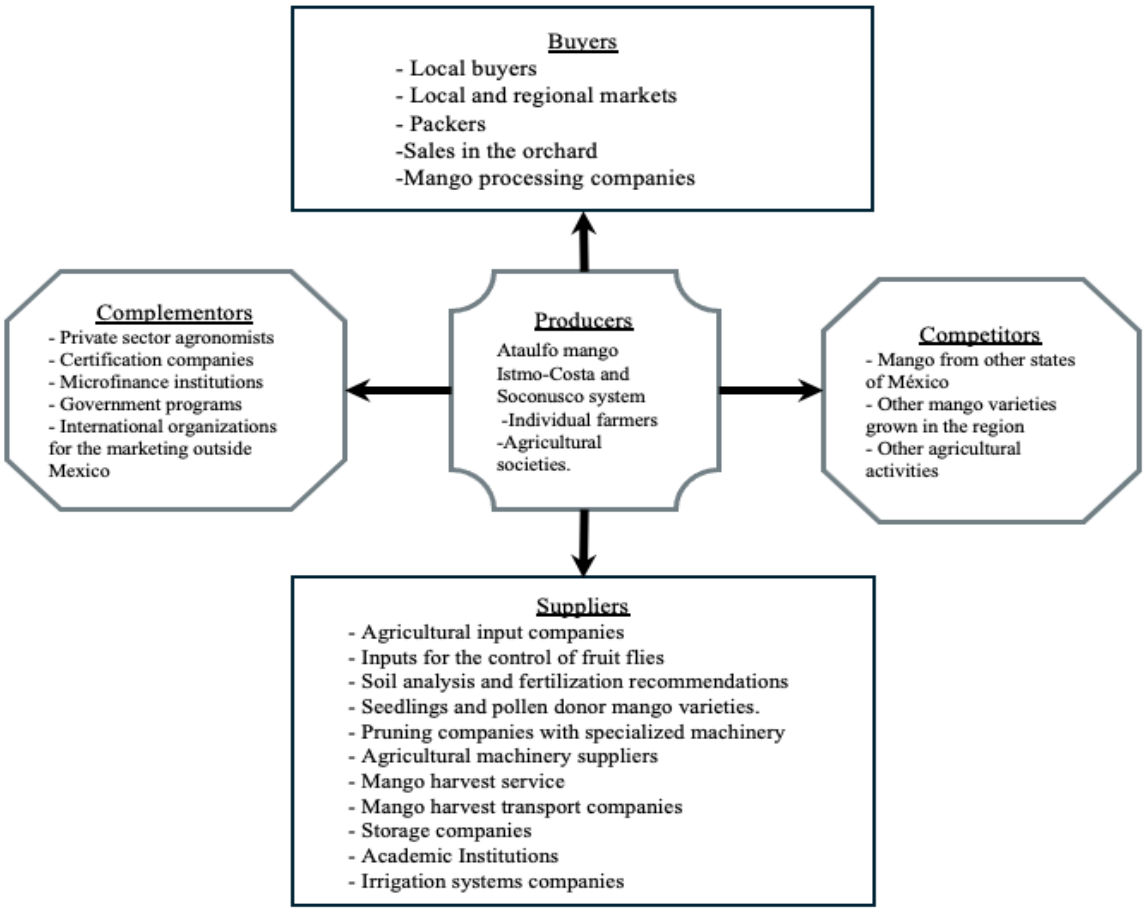


**Figure 1. The value network of the Ataulfo mango socio-environmental system in the Soconusco and Istmo-Costa regions, Chiapas, Mexico.**

**Producers**

*Unaffiliated producers*. Producers who are not affiliated with a formal agricultural society or cooperative represent a substantial portion of the Ataulfo mango producers in the study regions. These producers generally manage smaller orchards, interact mainly with local and national markets, and rely on traditional agricultural knowledge (Sumuano Barragán et al., in prep.). However, they provide employment within their communities, particularly seasonal labor during the harvest period. Also, their participation in the local economy helps sustain local businesses and services. Despite their smaller scale of operations, the collective impact of unaffiliated producers is considerable and supports the overall economic vitality of the region.

*Affiliated producers*. They are members of formal associations or cooperatives and have access to critical resources such as market information, advanced production skills, and international markets. They export to markets in the United States, Europe and Japan, which allows them to diversify their markets, ensure more competitive prices, and reduce the impact of low prices due to oversupply. Their profitability is significantly improved by these advantages (Sumuano-Barragán et al., in prep.).

**Suppliers**

Suppliers are among the most important actors for the Ataulfo mango socio-environmental system to function properly (Chay et al., 2019). Eleven groups of suppliers were identified:

*Agricultural input companies*. They supply key products such as fertilizers, herbicides, pesticides, and growth regulators to improve crop yields and to control pests and diseases. Their role is crucial in helping producers optimize the quality and harvest time of Ataulfo mango, especially during Mexico's most profitable sales season (December to March). In this context, Aparicio & Diaz (2015) report that in Bolivia the harvest date is a crucial element of better income opportunities.

*Inputs for the control of the Mexican fruit fly (*Anastrepha ludens Loew.*).* These inputs are designed to help producers with integrated pest management and include insecticidal products and kill traps with bait or attractants. However, many producers in the region do not implement actions to control fruit fly, despite being aware of its threat, and argue that their buyers do not require orchard management to comply with this activity.

*Soil analysis and fertilization recommendations*. Some companies provide soil analysis services to determine soil fertility of the mango orchards. Producers obtain samples from their orchards or pay for it. Locally, the *Universidad Autónoma de Chiapas*

(UNACH) offers soil fertility analyses at affordable prices. In Indonesia, soil fertility is a variable that affects the economic performance of mango (Sulistyowati et al., 2015).

*Seedlings and pollen donor mango varieties*. Specialized nurseries in the region sell seedlings of different mango varieties (Ataulfo, Kent, Oro, Manililla, Tommy, among others). Seedlings are essential for establishing new or rejuvenating old orchards. The *Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias* (INIFAP) promotes new improved and high-yielding varieties, such as Diamante, Citlalli, and Zafiro (Avendaño-Arrazate & Palacio-Martínez, 2019).

*Pruning companies with specialized machinery*. These pruners use saws and mechanical pruners to maintain the health and productivity of the mango orchard. In many orchards, however, pruners lack the necessary knowledge and equipment (using only machetes or small shears) to properly prune the mango trees, which can negatively impact tree health.

*Agricultural machinery suppliers*. These provide a wide range of equipment, such as tractors for land preparation and agro-input application systems. The low effectiveness of disease control is a persistent problem. This is mainly due to the lack of adequate aerial or ground spraying equipment with motorized backpacks. There has been growing interest in using drones for the foliar application of chemicals, although many farmers report to be unfamiliar with this technology. Some providers offer machinery rental services on a per hectare or per day basis.

*Mango harvest service*. This service is carried out by specialized work teams with the necessary skills to climb trees and pick the fruits, even those hanging at more than 20 m above the ground. In general, workers are paid per 30 kg crate of harvested mango or per day of work. This service is vital for producers who are confronted with physical limitations or advanced age. However, there is a shortage of people specialized in mango harvesting, especially among small producers, which can lead to harvest delays or higher fees to attract and hire skilled workers. Producer-members of agricultural associations often share equipment recommendations and align their harvesting schedules to address the shortage of specialized workers.

*Mango harvest transport companies*. These companies transport the mango harvest from the orchard to buyers or fruit packers and guarantee the efficient and timely distribution of the harvest through marketing channels.

*Storage companies*. They provide facilities for the storage of fresh fruit until marketing or further processing, guaranteeing that the quality and freshness of the harvest are preserved for an extended period of time. Fruit packers usually have the infrastructure required to render this service.

*Academic institutions*. They are dedicated to the research and development of new technologies, agricultural practices, genetic improvement, pest and disease control, among others. They are also involved in improving the productivity and sustainability of mango orchards. INIFAP, UNACH, and the *El Colegio de la Frontera Sur* (ECOSUR) are examples of institutions that are active in the study region.

*Irrigation system companies*. They offer the design, installation, and maintenance of irrigation systems for improved water management in mango orchards. Although many orchards lack irrigation, some are equipped with specialized pumps to extract water from the ground or natural sources (such as rivers). However, these companies have little interest in small producers. Also, no significant efforts have been made to demonstrate the advantages of irrigation for mango production to potential customers.

**Buyers**

In the study region, local buyers, packers, exporters, and industrializers (Figure 2) are the main actors who buy the mango harvest. Buyer diversity is low, however, which limits market opportunities and increases the vulnerability of producers to fluctuations in demand and prices, as has been reported from the State of Guerrero, Mexico (Astudillo-Miller et al., 2020).

*Local buyers*. Producers sell the fruit in 30 kg crates to collection centers that operate in the region during the harvest, from December to May. Local buyers purchase either harvested mangoes in crates (independently harvested by the producer, paying per crate) or the unpicked harvest (harvesting organized by buyer). The producer may be paid immediately or until a later date which, as a study from the municipality of Huehuetán, Chiapas indicates (Mazariegos Sánchez et al. 2017), can affect the liquidity and reinvestment capacity of the producers. Prices per crate of Ataulfo mango can vary greatly, from $64 USD ($1,300 MX) to $2.5 USD ($50 MX) in low and high-production seasons, respectively. Some local buyers overfill the crates (colloquially called *copeteo*) or pay in advance (*cajas a cuenta*), and add additional mangoes to the purchased crates or receive extra crates for free.

*Local and regional markets*. These markets are open-air spaces that serve the local community and residents of the region. The largest market of this type is the market of San Juan in the municipality of Tapachula. There are also small stores or markets - local and regional fruit shops -that buy smaller volumes of mango (Ataulfo as well as other varieties).

*Packers*. Packers prepare and pack mangoes for sale and distribution, and acquire different qualities of fruit in 20 kg crates. Their reach is local or regional, and they are able to export the mangoes if they meet international quality and food safety standards. Owners of these businesses have access to a wide range of services, from equipment maintenance to pest control. For mango, payment terms to producers vary, from 7 to 60 days for export sales and maximum 15 days for domestic markets. Packers are subject to pest inspection by government agencies as they must comply with phytosanitary and quality standards to maintain market access. Inspection agencies are authorized to confiscate and destroy fruit that is infested with live fruit fly larvae, and can trace back the

fruit to the packing house and orchard where it had been harvested.

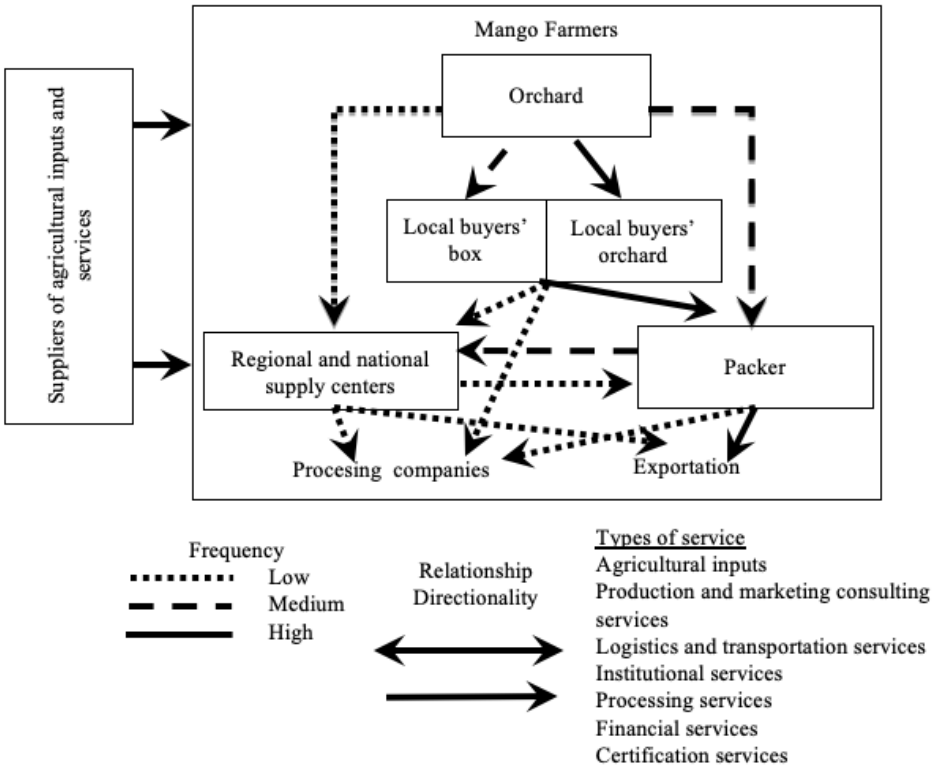


**Figure 2. Ataulfo mango marketing chain in the Soconusco and Istmo-Costa regions of Chiapas, Mexico.**

*Sales in the orchards*. Some producers prefer to offer mangoes to buyers directly from their orchards, allowing customers to purchase fresh fruit. This sales method generally attracts local consumers who value the freshness and quality of the Ataulfo mango.

*Mango processing companies*. These companies process Ataulfo mango into juices, jams, nectars, and other products. Although they demand a certain standard of fruit quality, they don't insist on strict appearance criteria, so they buy fruit that does not meet export standards. Despite the high quality of the products and production volumes, these companies have only a limited presence in the region. There are currently two industrial dehydrating plants in the study region, one of them with organic certification and sales potential in national and international dried mango markets. Small companies produce jams, sauces, and liqueurs, but their reach is mainly limited to the local market. Because of the limited market presence of companies that add value to mango, there is an opportunity for growth and diversification in this market segment, as suggested by Parrot et al. (2022) for Burkina Faso, where mango production is divided into five types of supply chains.

**Competitors**

Competition between actors in the Ataulfo mango value network can affect production and marketing profits.

*Mango producers from other states of Mexico*. Mexican producers from states other than Chiapas compete for the national as well as international market. The main competitor states are Nayarit, and Guerrero (SIAP, 2023). Producers from other regions of Mexico may have access to different technologies, grow under other climatic conditions, and have different production costs, which influence their ability to offer Ataulfo mangoes at competitive prices.

*Other mango varieties grown in the region*. Mango varieties other than Ataulfo may have specific characteristics (flavor, size, color, shipping resistance) that influence consumer preference and drive market demand. Among these varieties, the most common are Manillilla, Criollos, Oro, and Tommy

*Other agricultural activities*. The cultivation of other plants and the creation of pastures for livestock can subtract land used for the production of Ataulfo mango. Land in the study region that was previously used for growing Ataulfo mango is now used for oil palm, sugar cane, corn, and livestock. Changes in market demand, changing weather conditions that favor different crops, and government programs that aim to diversify agricultural production, have induced the displacement of mango cultivation by other agricultural activities.

**Complementors**

These actors provide additional or complementary support and services to the Ataulfo mango value network. Although they have been recognized to play a crucial role in supporting the production and marketing of mango in the study region, it has been reported that small producers have limited access to their specialized services (Mendoza-Hernández et al., 2020). This highlights

the need to develop programs and policies that promote equitable access to these resources, especially for small producers, to increase production and improve fruit quality.

*Private sector agronomists*. Agronomists provide technical advice and consulting services to mango producers. With their experience and specialized knowledge, they help farmers to improve cropping practices, increase productivity, and address specific challenges related to pest management, fertilization, irrigation, and other technical issues.

*Certification companies*. These specialized bodies assess and ensure compliance with quality standards, food safety rules, sustainable agricultural practices, or other specific mango industry requirements. Certification may be required to gain access to demanding national and international markets, and add value to the product.

*Microfinance institutions*. Bodies, such as the *Fideicomisos Instituidos en Relación con la Agricultura* (FIRA) in Mexico, provide financial services (for example credit, loans, or financial advice), especially to small producers and agricultural entrepreneurs. However, most of the producers claim these institutions only finance large producers. Access to financial services is often necessary if the producers want to invest in production improvements, acquire inputs, technology, or infrastructure, and overcome economic barriers that limit business growth, as Rasmikayati et al. (2020) reported for the Indonesian mango industry.

*Government programs*. These programs can provide subsidies, tax incentives, training, technical assistance and other types of support for the development and strengthening of the agricultural sector, including Ataulfo mango production. Programs are generally aimed at improving productivity, encouraging the implementation of sustainable practices, promoting innovation, facilitating market access, or improving infrastructure (SAGARPA, 2017). The local trade route network, including the recently modernized Tapachula International Airport and the port of Puerto Chiapas, are essential for the transportation of agricultural products to and trade with global markets.

*International organizations for the marketing of mango outside of Mexico*. These agencies work with Mexican producers and exporters to facilitate the marketing of Ataulfo mango in international markets. They provide product promotion support, identify market opportunities, inform on export regulations and requirements, and facilitate participation in international trade fairs and events. They aid the expansion of export opportunities and play an important role in increasing the competitiveness of Mexican mango on the international market.

## CONCLUSION

The Ataulfo mango value network in the Soconusco and Istmo-Costa regions of Chiapas is a complex and functional network of producers, customers, suppliers, complementors and competitors, whose activities and services are crucial for mango production, processing, and distribution. Each actor group plays a vital role in the network, from providing agricultural inputs and machinery to packaging facilities and transportation services. However, for the well-functioning and competitiveness of this value network, notable challenges remain, such as the need to improve pruning practices and control of pests and diseases, facilitate access to credit and insurance, increase labor supply for mango harvesting, develop adequate irrigation infrastructure, prepare technical advisers, launch government support programs to assist producers, and maintain and improve connectivity. Addressing these challenges requires comprehensive and holistic collaboration among industry stakeholders, strengthened by continued support from government agencies and non-governmental organizations. By encouraging cooperation and support, the sustainability, competitiveness, and profitability of the production of Ataulfo mango, a vital socio-environmental system for southern Chiapas, could be bolstered and guaranteed.

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