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Dragon Fruit in Ecuador

Victor Barrera
Alexis Villacis
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Luis Escudero

Department of Research and
Chief Economist /
Institutions for Development
Sector/
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Victor Barrera*

Alexis Villacis**

Jeffrey Alwang***

Luis Escudero*

* Instituto Nacional de Investigaciones Agropecuarias, Ecuador

** W.P. Carey School of Business, Morrison School of Agribusiness, Arizona State University

*** Department of Agricultural and Applied Economics, Virginia Tech

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Abstract*

Expanding incomes in Asian countries and changes in fresh-fruit value chains have created an important niche for producers of dragon fruit. Ecuadorean producers have responded and taken advantage of these evolving opportunities and market dynamism. By customizing their products to the specific demands of target markets and complying with the standards imposed by modern buyers, Ecuadorean exporters of dragon fruit demonstrate how challenges related to and opportunities in agri-food markets evolution can be met. This study documents the development of the dragon fruit market in Ecuador, with a special emphasis on the analysis of its value chain. The study additionally identifies and analyzes the main drivers of the success of the production and exports of the fruit and examines the main challenges and needs for improved public policies to promote sustainable growth of the sector. Findings are complemented with interviews conducted with the principal actors in the Ecuadorian dragon fruit industry, as well as a case study that involves several relatively recently formed dragon fruit-producing companies in the Amazon region of the country.

JEL classifications: D4, L1, M38, O12, Q01, Q12, Q13

Keywords: Agroindustry, Exports, Value chain

* This paper was undertaken as part of the IDB and IDB Invest project “Private and Public Strategies for Success in Modern Agri-Food Markets.” Primary information for this study was collected through interviews with 25 actors in the dragon fruit value chain in Ecuador during the spring and summer of 2020. The leaders of the following producer associations were interviewed: i) Asociación de Productores y Comercializadores de Pitahaya y Otros Productos Palora (APCPYOPP), ii) Asociación de Productores Pitahayeros Shuar (APPS), and iii) Asociación de Productores de Pitahaya y Cultivos Alternativos de Pastaza (APPCAP). In addition, we interviewed producers from the Los Ríos and Guayas province, and public institutions such as AGROCALIDAD and the Ministry of Agriculture and Livestock (MAG). Interviews with exporting companies included i) Finca Prócel, ii) Pita Fresh and iii) Agrícola Opla. Additionally, a focus group discussion was conducted with producers from Palora Canton, located in the Ecuadorian Amazon.

1. Introduction

Dragon fruit (*Selenicereus sp.*) is an exotic tropical fruit belonging to the Cactaceae family, native to Central America and parts of South America. It was discovered by the Spanish conquerors, who gave it the name dragon fruit (Sotomayor et al., 2019). Currently, it is grown in Mexico, Bolivia, Peru, Colombia, Venezuela, Ecuador, Israel, Central America and the Antilles (Sotomayor et al., 2019; Patiño, 2002).

Two types of dragon fruit are cultivated in Ecuador: the yellow variety and the red variety. These varieties, despite their sweet taste, are low-calorie (38.76 calories per 100 grams), and high in vitamin C. The yellow dragon fruit, also produced in Colombia and Israel, is highly demanded due to its yellow skin and aromatic white pulp with small black seeds. It is accepted in the national and international market for its taste, appearance, quality and nutraceutical properties (Vargas et al., 2020). There are two subtypes (ecotypes) of yellow dragon fruit, the “Pichincha” or “Nacional” (150 g on average), grown in northwestern Ecuador; and “Palora” (350 g), cultivated in the Amazon region (Trujillo, 2014). In June 2018, the Palora subtype obtained a protected designation of origin (PDO) as Dragon Fruit Amazónica de Palora (SENADI, 2018). The red dragon fruit is grown mainly in Mexico, Nicaragua and Vietnam. This differs from the yellow dragon fruit by the presence of bracts instead of thorns. Its pulp can be white or light red with small black seeds (Sotomayor et al., 2019).

In 1994 dragon fruit began to be cultivated in Bolívar province, using native Ecuadorian germplasm. This cultivation began with a small group of farmers and quickly gained notoriety as a profitable alternative to replace basic crops, and as an exotic product with an increasing demand. The cultivation of dragon fruit spread to other provinces, and it is now primarily grown in Morona Santiago. This province in 2019 had 624 producers representing approximately 65 percent of the 960 growers found nationally (AGROCALIDAD, 2020). It is estimated that 90 percent of producers cultivate less than three hectares (ha) and the other 10 percent three or more. In addition, another 1,200 actors participate in the dragon fruit value chain, which is equivalent to a direct influence on 10,780 people.

In Ecuador, approximately 2,180 hectares are planted with dragon fruit; of these, about 1,500 ha currently produce fruit, generating 16,660 tons of fruit per year. This translates into an average yield of 10.90 tons/ha (AGROCALIDAD, 2020; MAG-SIPA, 2019; INEC-ESPAC, 2019;

Vargas et al., 2020). This yield is lower¹ than in Colombia, where averages of 12.50 tons/ha of fruit ranging between 200-300 grams are reported.

Ecuador has recently become an important producer and exporter of yellow dragon fruit and competes directly with Colombian exports. Ecuadorian exports of yellow dragon fruit to Europe began in 1999 and have been growing over time. At the start of the export boom, Germany was the main destination. According to information reported by the Central Bank of Ecuador (2020), in 2019 Ecuador exported 7,500 tons of dragon fruit with an FOB value of USD 44 million, mainly to the United States and Hong Kong. An additional 9,160 tons were sold to the national market, and exported through informal channels to Peru, Colombia and Chile. The fruit is demanded in international markets, and new markets for its export continue to be sought.

Most dragon fruit producers in Ecuador have developed their own production technologies² by adopting and adjusting practices recommended for management of other fruit. The national agricultural research institute (INIAP) has not developed suitable dragon fruit germplasm. The exported variety, *Palora*, is a landrace from indigenous germplasm. These factors have limited productivity in Ecuador. For example, due to heavy pest and disease pressure in growing regions, most dragon fruit producers use pesticides, but they do so in an inappropriate way, since no specific technology has been developed and diffused (INIAP, 2020). Considering the accelerated growth of the sector over the last decade, it is surprising that there is no public policy or plan from the Government to assist this sector.

The objectives of this study include the following: i) documenting the development of the dragon fruit market in Ecuador, with a special emphasis on the analysis of its value chain; ii) identifying and analyzing the main drivers of the success of the production and exports of dragon fruit; and iii) identifying challenges and needs for improved public policies to promote sustainable growth of Ecuador's dragon fruit sector.

The rest of this paper is organized as follows. Section 2 presents a description of the dragon fruit value chain in Ecuador. This section discusses production, marketing, exports, and prices of dragon fruit. The national and international markets and the role of the government and public

¹ A recent study of dragon fruit in agroforestry systems carried out by the National Institute of Agricultural Research (INIAP) of Ecuador reported an average yield, stabilized after the fourth year of production, of 15.00 tons/ha (Vargas et al., 2020).

² Dragon fruit producers in Colombia use production technology generated by the Instituto Colombiano Agropecuario (ICA) (Kondo et al., 2013).

entities in this sector are also analyzed. In Section 3, a case study is presented to illustrate the country's potential to produce and export dragon fruit. This case study involves several relatively recently formed dragon fruit producing companies in the Amazon. Company strategies are described, complemented with a discussion of i) the role of certifications, ii) the role of some of the key public goods necessary to facilitate these processes, and iii) the effect of the COVID-19 pandemic. Current and future challenges facing the sector are discussed in Section 4, which also discusses needs for improved public policies to facilitate the sector's modernization. Section 5 contains lessons learned and conclusions.

2. The State of the Dragon Fruit Value Chain

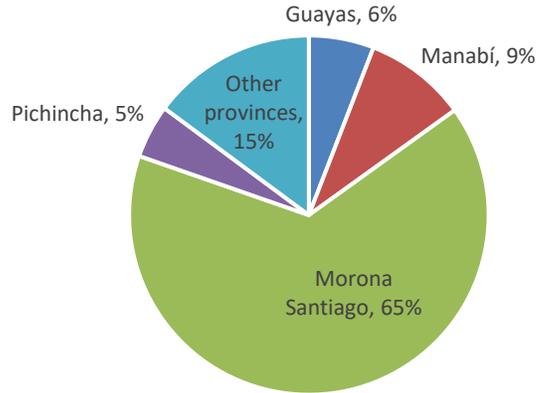
2.1 The Dragon Fruit Value Chain

2.1.1 Production

Dragon fruit was first collected and reported in Ecuador by Lawesson in 1983 in Garza Coche, a town on the Yasuní River, in the Jatun Sacha Biological Reserve, 8 km from Misahuallí. Today, it is cultivated in 17 of 24 provinces, in both monoculture and agroforestry systems. Production is seasonal: in Ecuador, 60 percent is obtained between February and March; 5 percent in June; 15 percent between September and the first week of October; and 20 percent between mid-November and the first week of December (Vargas et al., 2020). Seasonality, however, has not had an adverse effect on production, as all exports have been absorbed into global markets. Experts indicate that the seasonal pattern of production can be altered by agronomic management, so even if some export windows become saturated, Ecuadorean producers could adjust. These adjustment costs, however, are estimated to be high.

At the national level, in 2019, 1,530 hectares of dragon fruit existed, with a production of 16,660 tons. The highest concentration of cultivation is in the Amazon province of Morona Santiago (Figure 1). Morona Santiago has around 624 farms producing yellow dragon fruit, totaling 1,248 hectares planted. It is followed by the coastal province of Manabí, which has 88 farms and 264 hectares of yellow and red dragon fruit; Guayas, which has 56 farms with 168 hectares of yellow and red dragon fruit; and Pichincha, which has 46 farms and roughly 140 hectares of the yellow variety. Other producing provinces report 142 farms with 365 hectares of yellow and red dragon fruit (AGROCALIDAD, 2020).

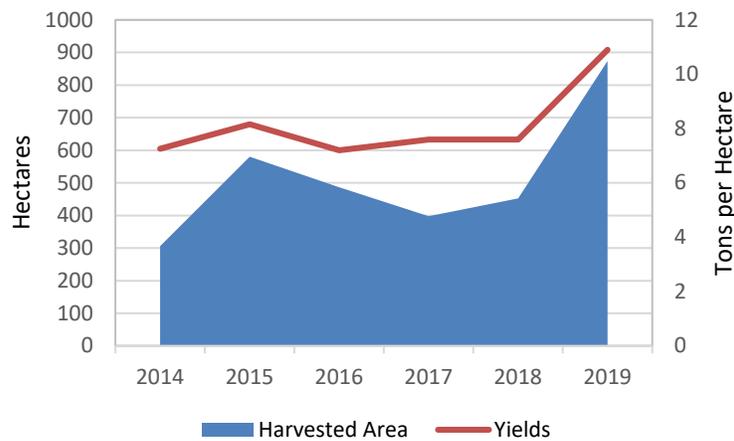
Figure 1. Geographic Distribution of Dragon Fruit Production in Ecuador by Province



Data source: Agrocalidad (2020).

Historical information on dragon fruit harvested area (tons) and yields (tons/ha) in Ecuador only exists for Morona Santiago province. The evolution of these indicators is shown in Figure 2. In 2019, Morona Santiago province reported a production of 9,527 tons, and its reported exports reached 7,499 tons (BCE, 2020).

Figure 2. Area, Production and Yields of Dragon Fruit in the Province of Morona Santiago, Ecuador for the Period 2014-2019



Data source: INEC-ESPAC (2019)

The sector lacks localized production technologies which would enable yield increases and better management of diseases. Pest and disease problems, lack of knowledge of the developmental and different physiological stages, and fertilization management are some of the biggest challenges faced by producers. Effective research is necessary if Ecuador's industry is to remain competitive due to evolving and increasing pest pressures. As few varieties are available, emergence of a serious disease could have disastrous consequences for the entire value chain.

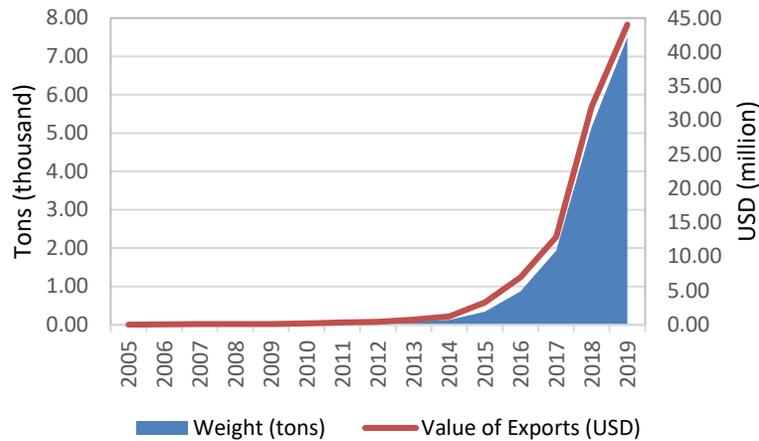
Dragon fruit requires about four years of growth before reaching a full stage of production. Due to the long-term investment implied by this maturation process, access to credit can be a critical consideration in starting production. Agricultural producers in Ecuador have little access to formal credit; only 4.2 percent of producers finance operations through loans from public or private banks³ (INEC, 2020). During the focus groups organized for this study, producers identified the main problems related to credit access as: i) slow bureaucratic processes, with requirements that most producers do not meet; and ii) lack of monitoring and technical support for the correct implementation of investments (INIAP, 2020). When individual producers were interviewed, they did not indicate that lack of credit slowed their operations, and most stated that the finance for their dragon fruit operations came from own savings and informal loans from family and friends.

2.1.2 Exports

In 2019 dragon fruit exports from Ecuador were valued at 44.05 million USD, corresponding to 7,499 tons (BCE, 2020), as shown in Figure 3. Between 2005 and 2019 the volume of dragon fruit exports grew by 79 percent, an increase in value of 84 percent. The reference price for dragon fruit exports has also shown substantial growth during this period, increasing from 933 to 5,874 USD per ton. The year with the lowest reference export price was 2006 with USD 881 per ton, while the year with the highest price was 2014 with USD 9,984 per ton (Figure 3).

³ The vast majority of producers, that is 94.1 percent, say they finance their activities through their own income.

Figure 3. Dragon Fruit Exports from Ecuador, 2005-2019



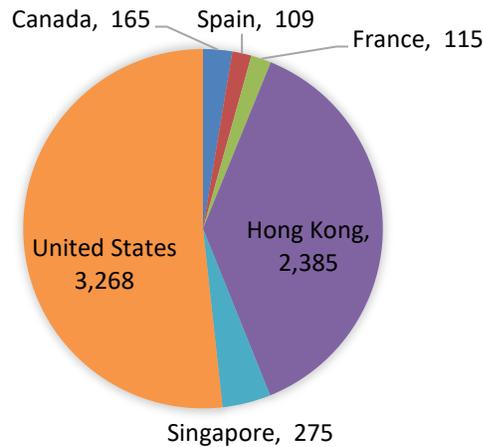
Data source: Central Bank of Ecuador, 2020.

Main destinations for Ecuador’s dragon fruit exports during 2009 to 2019 are shown in Figure 4. In 2019, the main markets were the United States and Hong Kong.⁴ The United States absorbed 43.58 percent of exports, valued at 19.20 million USD, and Hong Kong absorbed 31.81 percent (14.01 million USD). Other importing markets were Spain, France, Canada and Singapore. The following markets are currently open for Ecuador’s dragon fruit: the 28 countries of the European Community, the United States, Canada, Colombia, the United Arab Emirates, the Philippines, Hong Kong, Hungary, Indonesia, Lebanon, Malaysia, the Maldives, Russia, Singapore and Uruguay (ECB, 2020). The destination markets will continue to expand, as Ecuador’s exports are expected to enter China and Russia soon. The Palora *mesa de pitahaya* (a group representing producers and other stakeholders) entered into negotiations with the Chinese government and has agreed upon a protocol for dragon fruit export to that country. Ecuador’s government has not, however, agreed to certain conditions set forth by China. It is nonetheless expected that over the next two years exports to this huge market will occur. MAG, together with ASOPITAHAYA,⁵ and other multinationals continue to search for new markets.

⁴ The United States became the main importer of dragon fruit, surpassing Hong Kong which was, until 2018, the main buyer of dragon fruit from Ecuador.

⁵ Formerly known as Asociación de Productores de Pitahaya del Ecuador (APPE), created in 2005.

Figure 4. Destination of Ecuadorian Dragon Fruit Exports in 2019 (tons)



Data source: Central Bank of Ecuador (2020).

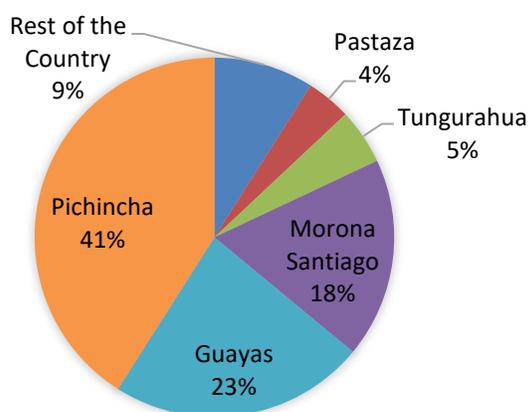
Ecuador's first dragon fruit exports to the United States market occurred in 2019. The first US-bound shipment, in February 2019, weighed 240 kg and originated from a greenhouse production facility of 5,000 m² certified as a site free of fruit flies and with production certified as organic. AGROCALIDAD, the national agency charged with responsibility to ensure compliance with food-related regulations, conducted the phytosanitary inspection at the Collection Center of Compañía Ecuatoriana del Té C.A. (CETCA), located in Palora, Morona Santiago. According to the National Fruit Fly Project (AGROCALIDAD, 2018), 1,478 hectares of dragon fruit were being monitored nationwide during 2019.

In the international market, the barriers to Ecuadorian dragon fruit exports are not tariffs but quarantine barriers. When it comes to quarantine, one of the most difficult countries is the United States. In the United States, Ecuadorian dragon fruit is allowed access through all ports of entry, but the fruit requires a steam treatment to ensure freedom from fruit fly contamination. For the European Union, tariff provisions for importation of products are unified, and dragon fruit from Ecuador is exempt from paying tariffs under the Generalized System of Preferences. In the European market, the phytosanitary restrictions and quality standards for the entry of Ecuadorian dragon fruit are less demanding than those of the United States. However, it is understood that the fruit must be of optimum quality, as a prerequisite for acceptance. Only shipments containing 0.01 percent or less of agrochemical residues are admitted. This a challenging restriction since research on biological, clean, or ecological products for dragon fruit is practically nonexistent in Ecuador.

This is a clear area for necessary research and, given the exponential growth in exports, research that will have high returns. As will be discussed below, Ecuadorean dragon fruit producers could gain from increased demand for sanitary/organic production.

In 2014, six companies exported dragon fruit, including Agrícola Pitacava, Earthfructifera and Sangay Pitahaya (BCE, 2020). This export base has grown dramatically, and by 2019 more than 96 companies were exporting dragon fruit. Most exporting companies are found in Pichincha⁶ (Figure 5).

Figure 5. Distribution of Location of Exporting Companies of Dragon Fruit in Ecuador



Source: Authors' compilation.

2.1.3 Marketing

Of all the dragon fruit produced by Ecuador in 2019, 45 percent (7,499 tons) was reported as official exports (ECB, 2020) while 55 percent (9,162 tons) was distributed to domestic markets⁷ (including wholesalers, retailers, local merchants, stores and supermarkets) and to informal exports, including markets such as Colombia, Peru, and Chile. The domestic value chain⁸ has a high

⁶ Examples in Morona Santiago include: Finca Prócel Cía. Ltda., Agrícola Opla, Hidalgo Trelles Jorge Luis, López Gómez Damián Gustavo (Nanky Fruits), Prócel Olga Vyacheslavna, Ecuadorian Producer of Exotic Fruits Organpit Cía. Ltda., Productora y Comercializadora “Hmb Exoticfruit” Hmblcom Cía. Ltda., and Rojas Calva Neli Patricia.

⁷ Ecuadorean consumers use dragon fruit in salads, juices, ice cream, yogurt, jam, jelly, cocktails, energizers, and desserts.

⁸ The Appendix illustrates the dragon fruit value chain in Ecuador.

presence of intermediaries fulfilling various roles such as packaging, transfer, and transportation. Some producers, especially in Guayas, sell dragon fruit directly to exporters.⁹ These types of producers generally have certifications such as BMP certifications provided by AGROCALIDAD and Global GAP certification, provided by third-party certifiers.

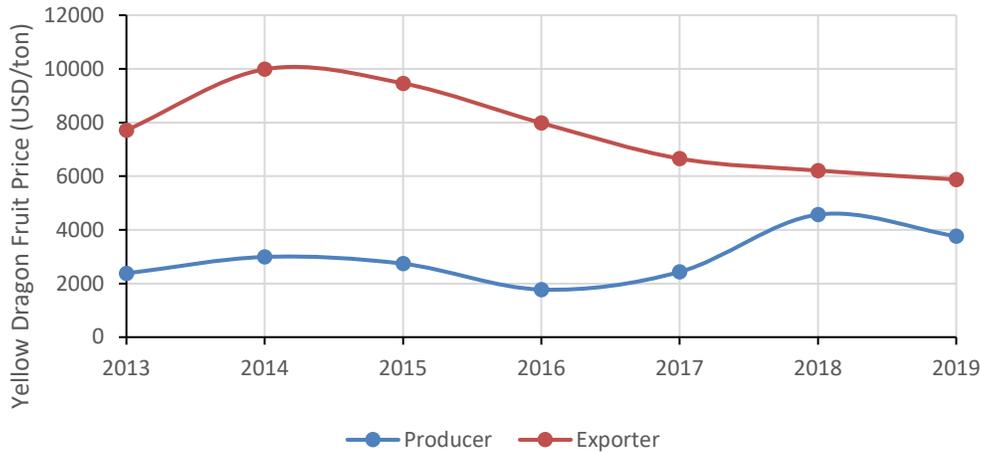
Several examples of associativity are found among producers. Examples of dragon fruit associations include Asociación de Productores y Comercializadores de Pitahaya y Otros Productos Palora (APCPYOPP), Finca Prócel, Agrícola Opla, and Pita Fresh from Morona Santiago, as well as “Agrícola Pitacava Cía. Ltda.” from Quito. Dragon fruit stakeholders are also organized into provincial “boards” (mesas). These mesas are led out of the Ministry of Agriculture and actors in the value chain participate, such as AGROCALIDAD, INIAP, producers, exporters, producer associations and local governments.

2.1.4 Producer and Exporter Prices

Most of the producer groups now directly export yellow dragon fruit, eliminating intermediaries, and the growth in organization of producer associations corresponds to decreased leverage for intermediaries. This is one reason for the decline in differences between producer and exporter prices shown in Figure 6. Another explanation was that 2013-2014 corresponded to a small boom in exports to new markets. Yellow dragon fruit was new to many of these export markets and commanded a price premium partly due to its novelty. Over time, the novelty of the fruit disappeared and the gap between producer and export prices shrank.

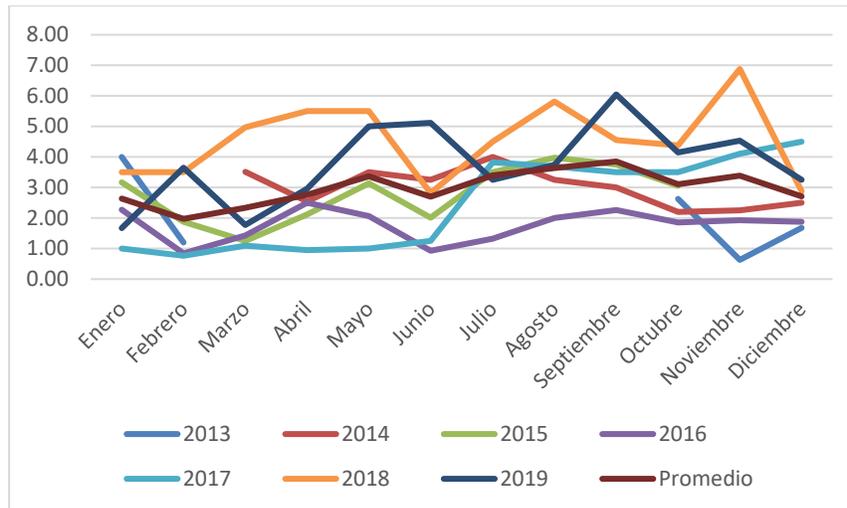
⁹ Normally between 20 percent and 40 percent of the fruit producers sell to exporters is rejected on quality grounds. Rejected fruit is generally sold in the national market or exported informally to neighboring countries.

Figure 6. Average Annual Price (USD/ton) for Producers and Exporters of Dragon Fruit in Ecuador, 2013-2019



Data source: MAC-SIPA, 2019.

Figure 7. Monthly Producer Prices (USD/kg) of Dragon Fruit, 2013-2019



Data source: MAC-SIPA (2019).

The price of dragon fruit at the producer level in 2019 averaged 3.76 USD per kilogram (MAG-SIPA, 2019). Within years, producer prices fluctuate substantially (Figure 7), generally being lowest during January-April and highest in July-September. During 2019, prices varied even more than average, with peak prices being obtained during April-June and again in September. Within-year price patterns vary by year, making it difficult to time production to correspond to

periods of high market prices. In the latest year for which data were available (2019), the domestic consumer price was about 4.50 USD per kg (MAG-SIPA, 2019).

2.1.5 Domestic Consumption of Dragon Fruit

There are no known studies of national consumption of fresh dragon fruit. Domestic consumption is considered to be quite low, and therefore most production is exported. The supply of dragon fruit for export is relatively stable throughout the year, since it comes from different regions of the country. A few wholesalers who handle other fruits participate in the domestic market; the main retailers involved in the dragon fruit market are supermarket chains such as Supermaxi, Akí, and Mi Comisariato. These companies purchase fruits from domestic brokers.

Technical Standard NTE-INEN-025, which is applicable to all fruits, regulates requirements for use in fresh consumption or as raw material for industry. This quality standard includes definitions, classification, size, packaging and labeling (INEN, 2005).

2.2 Role of the Government and Public Entities

2.2.1 INIAP (Research and Technology Transfer)

The growing international demand for Ecuadorian dragon fruit—attributed to its size and brix degrees— has generated interest in research on new management technologies and variety development to promote productivity and quality. Due to international market growth, development of new management technologies and post-harvest practices should be a priority if Ecuador is to remain competitive in the international arena. Interviewees expressed concerns about pesticide and other residues as producing areas have heavy pest pressures leading to application of substantial quantities of pesticides. Verifiable clean or organic production processes would enable further capture of credence-related demands in the developed world.

INIAP, Ecuador's national agricultural research entity, has developed a few technologies for dragon fruit, yet widespread adoption has not occurred. These technologies have been designed to be used in specific production areas in the Ecuadorian Amazon, and they have not been disseminated to other areas because climate and pest conditions vary by location. A benefit of widespread production is that harvests can be timed to meet demand windows, but a disadvantage is that production in different agroecologies may require different management practices. Another disadvantage is that the *Mesas* for dragon fruit are set up on a provincial level; for example, the

Mesa de Pitahaya de Palora acts in the interests of Palora producers and other components of the Palora-located value chain. Because the Mesa focuses on Palora-specific problems it cannot effectively lobby for the national industry's needs.

INIAP does not have sufficient budget for country-wide testing of all the fruits in different agroecologies. In addition, public agricultural extension is practically non-existent and diffusion is difficult under such circumstances. INIAP's National Fruit Program has generated and validated technologies for plant nutrition and pest management of dragon fruit specifically for Palora. Research has also investigated the suitability of dragon fruit in agroforestry systems. Such systems show promise because i) dragon fruit requires between 30 percent and 60 percent shade, ii) it does not tolerate extremely high temperatures, and iii) agroforestry may help to prevent crop stems from being exposed directly to the sun and hence avoiding burns that make the crop more susceptible to pests (Vargas et al., 2020).

2.2.2 AGROCALIDAD (Best Management Practices and Certifications)

AGROCALIDAD is the government agency in charge of the regulation and control of all food, agriculture, and natural resource-related issues in Ecuador. A basic requirement for food-producing farmers is that they register with AGROCALIDAD, and it is estimated that 80-90 percent of dragon fruit producers have done so. For exporters, AGROCALIDAD serves as an overseeing entity responsible for regulating compliance with different forms of certification. The Ecuadorian Accreditation Service (SAE) is responsible for accrediting the technical competence of certification organizations, but farmers or farmer groups need to document their certification to AGROCALIDAD. Several SAE-accredited companies provide Global GAP certifications, which is the most common certification used in dragon fruit.¹⁰

As noted, organic certification for export is not provided by AGROCALIDAD; instead, local exporters hire multinational companies such as IWUABE SS, CONTROL PERU, CERES, QCS and CID for their certification. These companies pay SAE for accreditation; costs of accreditation vary depending on the number of producers and volume of production. The mean cost (paid to SAE) for organic certification is 1,500 USD, but it reaches 5,000 for the largest industry (cacao). In addition to these payments, costs of organic certification are generally paid by

¹⁰ Kiwa BCS Ecuador and NBS International Ecuador are examples of Global GAP certifiers in Ecuador.

the producer (to the certifier). These costs vary by size of farm, location, and the destination of organic production. There are three primary destinations for certified productions: Ecuador's domestic market, the United States and the European Union.

At the farm or organization level, organic certification is renewed every three to five years, depending on the certifier. The best means for lowering the cost of certification is through group certification, which is common in cacao, but not in dragon fruit. When producer groups seek blanket certification, they need to demonstrate an internal system of control; compliance is made into one of joint liability. The costs of certification for a group will also vary by the size of its members and their degree of geographical dispersion. There are no government subsidies or support for these costs.¹¹

A major problem faced by Ecuador's exporters is that there are no established organic equivalencies with major importing regions such as North America, Europe and Asia. These equivalencies (that is, an equivalence between Ecuador's classification of organic with that of the importing region/country) would facilitate export to these target regions. Government is well aware of this challenge; since 2015 Ecuador has been trying to establish equivalencies with the European Union; in 2017, an EU delegation travelled to Ecuador to conduct a technical analysis and recommend improvements. In 2018, an agreement in principle had been reached, but obstacles emerged, and in 2019 the process was stalled by disagreements about the way forward. FAO is paying for a consultancy to identify changes to Ecuador's policies that would create equivalencies with US organic regulation. Lack of such equivalencies means that firms who desire to export to such markets need to comply with both national and receiving-country norms. One way to streamline the export certification process would be to ensure that national certification overlaps with those of major destination countries, yet the process of establishing all the correct equivalencies is a slow one.

Another challenge to organic certification is the difficulty producers face in producing organic dragon fruit. No domestic organic technologies are available, and producers claim that the added cost of organic production exceeds the market price difference between organic and other

¹¹ This is in contrast to the United States and European Union, both of which have public facilities for organic certification.

dragon fruit. This explains why producer groups do not certify together; few producers are interested in organic production.

One of AGROCALIDAD's main roles in the dragon fruit sector is to enforce the provisions set forth in the "Manual of Procedures for the Certification of Production Units in Good Agricultural Practices GAPs." This manual establishes the GAPs (Best Management Practices BMPs) certification procedures in agriculture and livestock production. It also regulates safety and conditions of workers.

2.2.3 MAG (Technical Assistance, Extension and Training)

In Ecuador, there are no established government agricultural extension programs. Extension is conducted through development agencies and private companies since 1987, the year when MAG promoted extension to be carried out by the private sector. This affects the production of dragon fruit, since MAG has not implemented any strategy to promote technical assistance, training and/or subsidies activities.

The dragon fruit sector has been developed by private initiatives. Producer organizations and some local governments where dragon fruit is produced have provided technical assistance, technology transfer, and training. Examples of these associations include the Association of Producers and Marketers of Dragon Fruit and Other Palora Products (APCPYOPP), the Association of Producers of Pitahayeros Shuar (APPS), the Association of Producers of Dragon Fruit and Alternative Crops of Pastaza (APPCAP), and the Sectional Government of Palora.

2.2.4 BanEcuador (Credit)

The Government of Ecuador, through the Minister of Agriculture and Livestock—who is the Chairman of the Board of BanEcuador—has been the only promoter of the development of specific credit lines for the cultivation of dragon fruit. BanEcuador (formerly known as Banco Nacional de Fomento) developed and approved in December of 2013 a credit line for various crops, which included dragon fruit. Additional public sector finance for producers does not exist, and private financial institutions have not developed credit lines customized for dragon fruit production, which requires a grace period. This has forced producers to rely on informal sources, as noted above. None of the associations we encountered have lent to producers/members.

3. The Success of Dragon Fruit Exporting Companies in the Ecuadorian Amazon

In this section, we discuss experiences of two successful dragon fruit producing and exporting companies located in the Ecuadorian Amazon: Finca Prócel and Agrícola Opla. Both firms are recently formed, and the inspiration for entering the dragon fruit export business came from founder/owner experiences working in the United States. These expatriates encountered dragon fruit at fruit markets and supermarkets in the United States, and by comparing price and quality with similar products in Ecuador, they decided they could build a business around production in Ecuador and export to the United States.

3.1 History

Finca Prócel (FP) is a family farm that began to cultivate yellow dragon fruit in 2008 with a production area of one hectare and with the intent to export to the US market. It has been quite successful and currently has 32 hectares under production with a fruit collection and packing plant. In average, the firm produces 400 tons of fruit per year. FP began export operations in December 2015, and it currently sends 20 tons of fresh fruit weekly. Exports go directly to client/distributors in the United States, Canada, Hong Kong and Singapore. The markets were identified by family members with experience in an international setting.

FP purchases fruit from other dragon fruit producers in the Palora region and has BMPs and Global GAP certifications, both for the farm and for its fruit collection and packing plant. Although fruit is harvested throughout the year, the peak seasons are from December to March and from September to October. To promote its product internationally, Finca Prócel created a website called “Pitahaya Palora” in 2008. This website has helped them establish direct relationships with international clients and in 2015 it helped them obtain clients from Hong Kong.

Agrícola Opla (AO) is a family business with 20 years of experience producing yellow dragon fruit. With 20 hectares of plantations, the company produces more than 400 tons per year and currently exports to the United States. The firm has Global GAP certification, facilitating export. To open new markets, AO sends samples of its product to potential clients. Unlike other companies, AO’s fruit reaches the final consumer with the original export packaging. The original idea for dragon fruit export came from the owner’s experience in the United States, where observed prices helped identify an opportunity for a profitable enterprise. At early stages, AO struggled to

produce sufficient quantity and quality for export, but the presence of a market opportunity was never in doubt. Prices have remained high partly because of the yellow skin and quality of the export. The firm's main challenge is finding sufficient exportable fruit, not locating new markets.

3.2 Business Model

3.2.1 Production and Relationship with Suppliers

Both companies make use of certifications—the BPA certification provided by AGROCALIDAD and the Global Gap certification. The main source of the fruit they export comes from their own production. Each company also acquires fruit from other producers who are also certified. These purchases are not based on contracts; instead, the firms base their relationship with other suppliers on loyalty. Most suppliers are relatives or long-term personal friends of the company. Neither buyers nor sellers expressed a preference for entering into contracts; the firms say there is too much uncertainty in international prices to fix a domestic contract price. The suppliers are not exclusive and many sell dragon fruit to other companies and intermediaries; they expressed a willingness to retain flexibility in their marketing options and thus avoid contracts. Finca Prócel and Agrícola Opla acquire an average of 60 tons and 100 tons of fruit per year from their suppliers, respectively. In both companies, the product is collected at their facilities. However, AO helps with transportation for several of its suppliers, who are generally medium-sized producers who own two to three hectares.

Due to not having purchase contracts, FP and AO suppliers may be tempted to sell their production to other companies or to intermediaries who may offer higher prices, especially off-season. To maintain relationships, the exporting companies generally pay higher than spot prices to their suppliers. The directors of both companies assure that their suppliers look to maintain and honor their relationships, since if they do not do so, they will be excluded from future transactions. Furthermore, FP and AO provide training to their suppliers, and the training makes it easier for the suppliers to achieve certification.

Success of the two firms has had spillover effects in local labor markets. Finca Prócel started its activities with a single worker and now has 30 permanent employees. It also employs 30 to 40 temporary workers during the high-season for exports. Agrícola Opla began with 27 permanent employees, and during the high season they now employ as many as 60 workers.

Both companies provide technical assistance to their suppliers for crop management. This assistance is mainly related to proper pesticide handling. Finca Prócel is making plans for providing suppliers/producers with low-toxicity chemical products and fertilizers, and training in handling and application. Fruit sold in international markets does not obtain price premia based on toxicity of pesticide used during production; fruits are either certified as organic or not, and organic fruits do receive higher prices in many markets. In the case of dragon fruit, however, the major exporters claim that the organic price premium in international markets does not compensate them adequately for the increased cost of organic production. Of course, where applicable, fruits must fall below country-specific residue tolerance, but non-organic fruit is sold only as not organic.

3.2.2 Markets and Exports

Dragon fruit is sold in both the national and international market. The best fruits that meet required quality standards are sold to international markets, while the fruit that does not meet the standards for export are sold domestically. The companies sell below export-quality fruit to local intermediaries, who in turn distribute it throughout the country and export informally to Peru. Finca Prócel also produces wines and jellies and marmalades using low-quality fruit. These products are basically a side-business that are not significant in overall firm earnings. The two companies assert that the growth in demand for yellow dragon fruit has been natural; consumers in importing countries appreciate the size, color and sweetness of Ecuadorean yellow dragon fruit. While Ecuador has similar agro-ecological conditions to Colombia, the Ecuadorean companies do not perceive Colombian exports to be a significant threat.

Finca Prócel sells most in the United States, Canada, Hong Kong and Singapore. Fruit sold in Canada is received at destination ports and repackaged by a distribution company with whom they have a relationship. This repackaging—into plastic bags with two dragon fruits per bag—is done to appeal to consumers. They are delivered to local markets and supermarket chains including Budget Foods, Buy-Low Foods, Nesters Market, Meinhardt Fine Foods, Quality Foods, Shop ‘n Save, AG Foods, Choices Markets and Nature’s Fare Markets. In Hong Kong, FP sells two grades of yellow dragon fruit: Premium and Common. After arriving at the destination, the dragon fruit is repackaged and mixed with similarly graded fruit from other sources and subsequently distributed to different parts of China. Distribution is the responsibility of a contracted firm; the relationship began with an internet contact and has grown into a formal contractual arrangement.

The FP representative does not have details on the distribution operations in the US and Singapore markets, except to say that they are received by brokers at the port of entry. Finca Prócel also sells domestically to the Ecuadorian supermarket chain “Supermaxi.” Finca Prócel representatives visit importing countries and promote and negotiate directly with buyers; market expansion has resulted from these personal ties. The volume of export has not reached levels where it is feasible to explore alternative distribution channels, and the firm is not large enough to undertake distribution on its own.

Table 1. Dragon Fruit Sales Operations, Finca Prócel, 2020

Item	Country of Destination				
	USA	Hong Kong	Canada	Singapur	Ecuador
Sales Volume High Season (kg/year)	95,600	191,200	76,480	19,120	17,600
Sales Price High Season (USD/kg)	5.20	5.40	5.20	6.00	0.90
Gross Revenue High Season (USD/year)	497,120	1,032,480	397,696	114,720	15,840
Sales Volume Low Season (kg/year)	4,780	66,920	23,900	-	4,400
Sales Price Low Season (USD/kg)	7.20	7.60	8.00	-	1.20
Gross Revenue Low Season (USD/year)	34,416	508,592	191,200	-	5,280
Total Gross Revenue (USD/year)	531,536	1,541,072	588,896	114,720	21,120

Source: Data provided by Freddy Prócel, 2020.

Table 1 shows Finca Prócel data on dates of sale, quantities sold, prices received, and revenues. Current annual revenues are about USD 2.7 million per year. The high production season generates the highest annual revenues (around USD 2 million). The low production season generates around USD 700 thousand, and prices are generally higher in the low season. Total annual sales volume are estimated at 500 tons, including the national market (22 tons) and the international markets (478 tons). In both seasons, Hong Kong accounted for the most sales. Prices in Singapore were highest during the high production season, and Canada paid the highest prices in the low season. Finca Prócel was asked about the obvious difference in prices according to season. The representative indicated that the company does not plan to coordinate production according to seasonal price differences, mainly because the costs of adjusting seasonality of production are high. The easiest way to “adjust production by season” would be to acquire fruit from different regions, but, because the company relies on personal contacts, it would be difficult

to switch sourcing to other regions. Of note is the price difference between Ecuador and other exporting countries. While fruits sold to the Ecuadorean markets are lower quality, the price differential partly reflects gains to participation in dragon fruit exports.

Agrícola Opla exports only to the United States. Personal contacts of the AO family promote dragon fruit for sales in supermarkets and stores, especially in Los Angeles, San Francisco, New York and Cincinnati. The model is quite different from that of FP and reflects the investments made by AO in the US market. In the United States, the fruit sent from Ecuador is received by brokers, who coordinate directly with the AO relatives residing in the country. Subsequently, the personal contacts distribute the fruit to small supermarkets, using their original packaging. The dragon fruit that AO sells in the international market is packed in 2.5 kg boxes, and unlike other exporters, its product is not mixed with fruit from other suppliers. The original boxes with the AO logo reach the final consumer. According to the owners of AO, this strategy helps them establish a market niche which has facilitated promotion of the brand. Agrícola Opla invites U.S. clients to visit its production, harvest and post-harvest facilities in Ecuador. By doing so, AO builds confidence in the credence attributes the company claims.

The dragon fruit business of Agrícola Opla generates revenues of about USD 2.06 million per year, with exclusive sales to the United States. The high production season generates the most revenues, approximately 1.2 million USD. The low season generates around 856 thousand USD. Its total annual sales are estimated at 500 tons, including the national market (40 tons) and the international market (460 tons). During the 2019 high production season, the price received was USD 8 dollars per box of 2.5 kg. In the low production season, the price received was USD 23 dollars per box. The representative of AO expressed no interest in trying to take advantage of seasonal price differences by switching sources and location of its supply.

3.2.3 Use of Certifications

Both companies have Global GAP and BPAs (BMPs) certifications for their own operations and assist their suppliers with maintaining their own certifications. Both companies stated that, in order to enter international markets, it is necessary to obtain certifications of good management practices, even if their products are not sold as organic. According to Finca Prócel and Agrícola Opla, both Hong Kong and Canada do not require certification, but the United States and Singapore do.

According to the companies, Global GAP specifically helps to export to the United S, Hong Kong, Canada, and Singapore. FP obtained Global GAP through the certifier “Kiwa BCS Ecuador,” and maintenance of the certification costs about USD 2,000 per year; AO obtained Global GAP through “NSF International Ecuador,” costing about USD 1,500 per year. Both firms are certified by AGROCALIDAD with BMPs,¹² as are their suppliers. The procedures for BMP certification are more complicated than those required by the Global GAP. Certification of BMPs lasts for a period of three years and has no cost, but every field needs to be inspected and AGROCALIDAD lacks capacity to certify on a timely basis; policies are being explored to contract out these services to private companies.

Ecuadorean dragon fruit producers have so far not exported large quantities of organic dragon fruit. This limited organic export is partly related to the relatively high cost of certification (noted above), but the major reason is that organic production is technically difficult in Ecuador. Pest and disease pressure in producing areas is such that organic control is very costly. Certification of groups is difficult because few producers want to undertake the challenge of full-scale organic production. The only documented organic exports of dragon fruit were undertaken by the company Te del Ecuador, who grew their fruits in a protected (greenhouse) environment.

3.2.4 Government Financing and Support

Finca Prócel and Agrícola Opla began operations with their own funds. Finca Prócel is a diversified entity, and capital came from firm profits. For AO, investment funds originated from capital obtained by owners while working abroad, and from remittances from other family members. Currently, the working capital in both companies comes from profits generated by the export of dragon fruit, but FP produces and sells other products. During the last year, FP borrowed about one million USD from BanEcuador to deal with a scam associated with buyers from Singapore. Neither company identified any source of government financial assistance to facilitate exports.

Government had no real role in the creation of these companies. Neither company could identify public policies or mechanisms that have supported production, but FP stated that PRO ECUADOR¹³ helped the firm identify export markets and facilitate compliance with export

¹² Of 624 dragon fruit producers in the Amazon region, only 50 have obtained an AGROCALIDAD BMP certificate.

¹³ PROECUADOR is a government institution that promotes exports and investment.

regulations. Since then, international promotion has been conducted by the firms, and each firm has pursued its own path. FP has sent representatives to potential importing countries and to export fairs, and it has aggressively sought markets through digital means. FP states that it has tried to involve the government, but the lack of personnel in institutions such as AGROCALIDAD remains a central problem and affects the speed of processes and procedures. AO mentions that the local government where their production is centered supported them with organization of fairs to promote consumption in the domestic market. For AO, the role of MAG has been uneven, but many of their producers have received training on crop management from different public sources. AO has not attempted to break into markets other than the United States, and its US distribution system is informal and not set up to do intensive marketing. Both companies say they hope to open new international markets with the help of PRO ECUADOR.

We found no evidence that producer groups were involved in identifying international markets. Due to the relatively small sizes of these firms, the overhead for a broad effort to promote the Ecuadorean product in international markets would be prohibitive. This is a clear area for increased public support, if only to strengthen and support producer associations in creating and coordinating a marketing effort. The reputation of the Ecuador brand is a public good, and a small and fragmented industry will undersupply the public good.

3.3 Quality Problems, Environmental Initiatives, and Covid-19

3.3.1 Quality problems

According to Finca Prócel the main quality problems related to export-quality dragon fruit include stains on the skin of the fruit and the fruit's maturity. These issues normally occur when suppliers harvest the fruit prematurely; the company works with producer/suppliers to provide management training as a part of its normal operation. It rejects low-quality fruit or pays lower prices and uses them for processing wines and other products. Agrícola Opla mentioned they have had problems related to a small size of the fruit, as they prioritize purchases from growers who deliver large and clean fruits. Both firms are careful in their quality control and work with small-scale suppliers to improve production.

3.3.2 Environment

Finca Prócel has an ecological reserve of 25 hectares with primary forest and motivates other producers to preserve their forests through good management practices. They also use low-toxicity pesticides (green and yellow seal) and state that they care for worker health by training in the proper use and handling of pesticides. Agrícola Opla promotes agroforestry systems and encourage the conservation of streams by avoiding their contamination with pesticides. With the support of the Autonomous Decentralized Government of Palora, AO supports creation of ordinances aiming at protecting and reforesting affected areas, as well as encouraging the recycling of pesticide containers. While neither of these companies has exploited these credence attributes, there is evidence of a clear corporate conscience that could be taken advantage of over time. For example, fair trade certification could be an option, but distribution in receiving countries is not set up to promote recognition of the fair trade dimension.

3.3.3 Covid-19

Finca Prócel stated that Covid-19 greatly affected the commercialization of the fruit during the peak of production in March, as the borders were closed and sales were practically lost, while what could be sold internally received very low prices. Agrícola Opla lost all its production for the month of March since there were no transportation services available and the production could not be moved.

4. Current and Future Challenges of the Sector

4.1 High Pesticide Content

In the Ecuadorian Amazon, specifically in Morona Santiago, the rapid transition of the dragon fruit ("Palora" ecotype) from wild to commercial cultivation has caused agronomic management problems, mainly related to pest control and excessive application of pesticides. In general, high pesticide content afflicts many fruits in Ecuador. Like producers of other fruits, dragon fruit producers will be affected when international markets impose stricter restrictions on pesticide residues. This problem will generate unwanted externalities even in producers who try to differentiate themselves in niche markets by producing certified organic dragon fruit.

AGROCALIDAD has certified many dragon fruit producers as users of BMPs, and BMP-training is a mechanism for production of cleaner fruit. However, currently no technical or

financial capacity exists to promote sector-wide BMP certification. AGROCALIDAD lacks the personnel for such an ambitious undertaking, and no other public initiatives focus on solutions to pesticide residues in fruits.

Recommendations from the different actors interviewed for this study include: i) resources for research institutions such as INIAP and local Universities to generate technologies for integrated management of pests and diseases (IPM) with an emphasis on pesticide reduction, and ii) increasing technical assistance and training for producers. This training should focus on field sanitation, removal of pruned material and fruits from the ground, and less-toxic alternative pesticides. Because inadequate research has been conducted on cleaner management options for dragon fruit, no known biological controls are available, and nothing has been done to develop resistant varieties.

4.2 Certifications and Dragon Fruit Production Systems

According to dragon fruit producers in Palora, few producers BMP occurs because AGROCALIDAD does not have sufficient personnel to certify all producers. According to AGROCALIDAD, most dragon fruit producers are not BMP-certified because main markets such as Hong Kong and Canada do not require certification. This argument is suspect, because there are certainly consumers in some of these markets who would value certifications. The national industry has its own reputation to defend and this public good can only be maintained through collective action or public sector actions. All producers have a vested interest in the global reputation of Ecuador's interests, and it would be difficult to maintain this reputation only in specific markets.

Currently, AGROCALIDAD is responsible for BMP certification. In the future, this certification will be privatized and carried out through Global GAP certification bodies. This change reflects tacit recognition of the institutional inadequacies of AGROCALIDAD. Privatization of this service will increase access to BMP certification and could further promote the use of certificates for exports. However, the cost may be prohibitive.

An efficient BMPs certification system could help determine which producers and areas suffer from quality problems, information that is currently lacking. It could help identify producers with high pesticide usage and train them to reduce this practice. Currently, certification of BMPs by AGROCALIDAD has no cost and is valid for a period of three years. Because the service is not

priced, however, its provision needs to be rationed, and many producers are unable to obtain certification. In contrast, the Global GAP international certification has a cost which fluctuates between USD 1,200 and USD 2,500 per year. This may create a cost squeeze for small-scale suppliers and suggests that public subsidies might be required. In the absence of a subsidy, producers might find it in their interest to “tax” all members to provide subsidies for small scale producers. Global certification will help enable an improved reputation in international markets.

Another area for improvement might be through enhanced post-harvest treatment of the fruit. While AO packaging allows it to separate its own product from others, FP exports are mixed with dragon fruits from other suppliers. The Ecuadorean industry might benefit from careful attention to its brand. All the interviewees discussed the high quality of Ecuador’s exports, and this quality could enable creation of a unique brand. Efforts such as advertising region of origin or simply a “grown in Ecuador” label might enable capture of additional value in international markets.

4.3 New Markets for Ecuadorian Dragon Fruit

Consumption and production of dragon fruit has increased in Asia over the past decade, especially in non-traditional countries such as China, Singapore and Hong Kong. Demand has also grown in the United States and the European Union. These countries represent potential markets to be explored and exploited, so there is a need for enhanced business intelligence and logistics. In these countries there is also growing consumption of organic products, which would represent a new opportunity for the production of dragon fruit in Ecuador. Organic production is still novel, and there is only one known success story.¹⁴ In addition, China is a market with almost unlimited growth potential, and clean certifications (rather than organic) may be adequate for successful entry there.

Some limitations related to the export of dragon fruit include i) requirements of small volumes by the dragon fruit consuming countries, which increases the transport costs per unit, and therefore the sale price; and ii) insufficient exportable supply of dragon fruit varieties for customers who require a constant supply throughout the year. With regard to the latter point, it will be

¹⁴ After extensive interviews with Ecuador’s producers, the only concrete case of organic export of dragon fruit we identified was in the small greenhouse operation of *Compañía de Te*.

important to establish new plantations to supply new markets; large volumes are needed to maintain markets in the long term.

4.4 Technology Transfer

Currently, there are no new dragon fruit technologies that are awaiting diffusion to producers. Without a ramping up of research efforts, technology transfer will focus on known practices for clean management such as field/plantation sanitation, adequate plant spacing and pesticide management. New technologies should include the following:

1. Integrated pest management technologies to reduced use of pesticides; these should control specific dragon fruit pests such as tobacco thrips, *Frankliniella occidentalis*, *Fusarium oxysporum*, *Fusarium solani*, *Alternaria alternata* and *Colletotrichum gloeosporioides*;
2. New varieties with high yields and high quality, developed from genotypes with promising resistance characteristics to the previously mentioned pests;
3. Fertigation management and plant-nutrition technologies;
4. Agroforestry systems that can improve soil quality as well as provide competitive yields when compared to conventional systems; and
5. Post-harvest practice technologies and training on fruit handling with a priority on final packaging of the product.

It will also be important to have i) a catalog or manual that can help with the recognition of pests and diseases that affect dragon fruit, and a (ii) registry of low toxicity agrochemicals that can be used for dragon fruit production.

4.5 Institutions and the Dragon Fruit Value Chain

Although this is a value chain with potentially high social and economic impacts, the actors in the dragon fruit value chain in the Ecuadorian Amazon point out that there is no space for a real dialogue and discussion of policies to help the sector. Producers and organizations would benefit if policy-specific recommendations could be discussed with the main authorities of the MAG, something they have been pushing during recent years without success. It is here that the sector boards (*mesas*) have been ineffective. Part of the challenge is the relative dispersion of producers

and interests that vary by location. This makes it expensive to organize for collective action. Current exporters have found a niche, have been able to train their own suppliers, and are less interested in broadening participation for others. Policymakers should consider expanding the geographical mandate of the provincial boards or providing guidance to creation of a national board.

5. Lessons Learned

The growth of the dragon fruit sector in Ecuador and its export has been rapid and impressive. This growth has been driven exclusively by the private sector and has been mostly concentrated in the Amazon region of Ecuador, although the fruit is also being produced in other regions of Ecuador, including the Coast and the Andes.

This non-traditional fruit has found the United States, Canada, Hong Kong and Singapore as its main consumers and destination markets. However, there are more markets where Ecuador could enter to take advantage of emerging opportunities. For this purpose, entry of new producers into the value chain must be promoted, since current production is not supplying all the potential demand. In addition to new geographic markets, high-value markets in current destinations that increasingly demand credence attributes, including organic production, and these represent even more opportunities for the dragon fruit sector in Ecuador.

In order to increase the success of this sector, and take advantage of market opportunities, the government can take a more active role in this sector and leverage the advances made by the private sector. Alternatively, government might strengthen the current regional boards to allow a national industry to emerge. Government actions that can have positive impacts on the dragon fruit value chain include: i) improving product quality, reducing waste, and encouraging organic production; ii) research, training, and regulation to ensure that quality is maintained and rewarded throughout the value chain; iii) facilitating and promote an efficient national certification system for dragon fruit (the cost can be paid in one way or another by the producers); and iv) creating an institution/office to facilitate exports and assist producers in this process.

The dragon fruit of Ecuador has competitive advantages that have not been fully exploited. The fruit stands out for its size, its smoothness and sweetness, and for its shape and color. These factors have helped producers to obtain better prices, but price variation within and between years is high and has slowed establishment of a stable market. Potential credence attributes have not

been exploited, partly due to the fragmentation of domestic production. Research is necessary to enable more environmentally sound production and organization of the industry will help standardize practices to enable defense of the reputation in rapidly growing and evolving markets.

The dragon fruit sector represents a potential source for the generation of jobs and resources in the Amazonian provinces. It has the potential to link small and medium producers in the Amazon region with global value chains. This will depend on the country's ability to identify and provide the public goods that help drive innovation and increase productivity throughout the value chain.

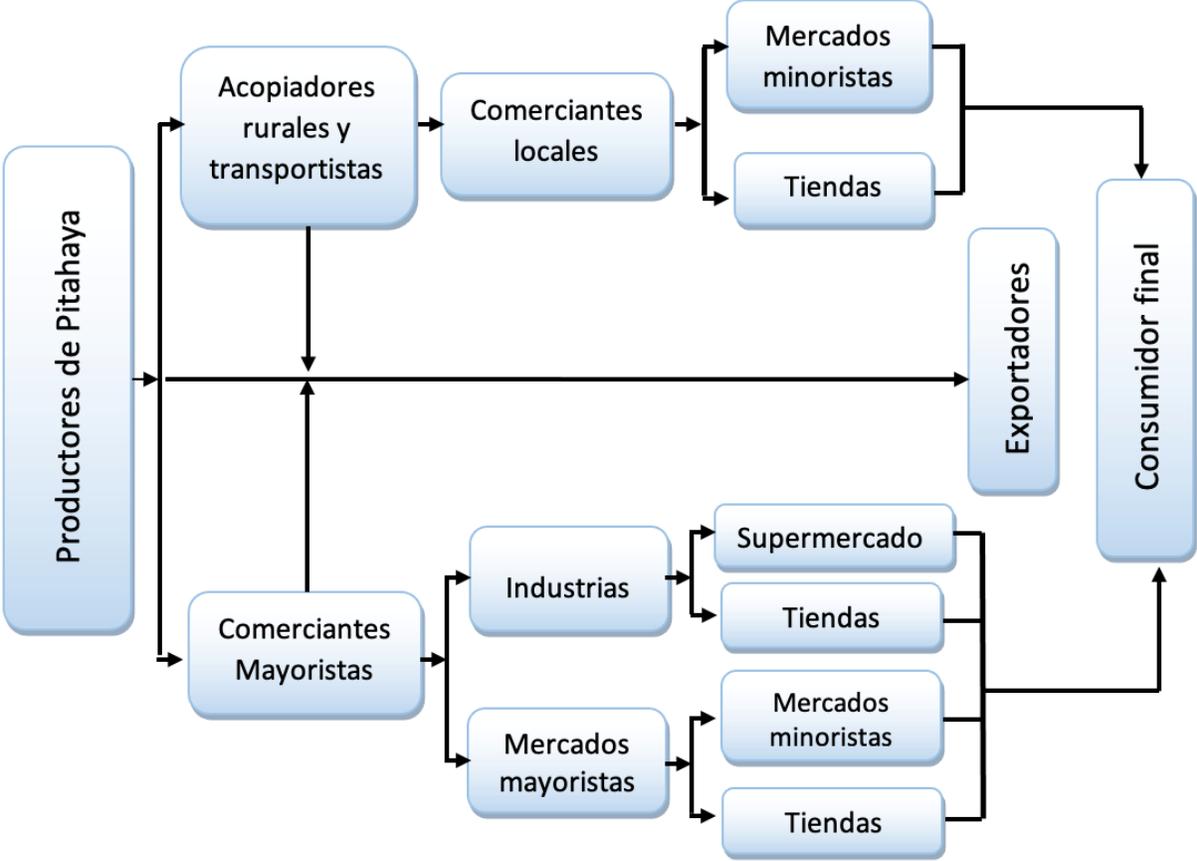
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Appendix

Figure A1. Commercialization Channels of Dragon Fruit in Ecuador.



BMPs Certification Procedures

In terms of BMPs certification, AGROCALIDAD indicates that there are mechanisms for their applicability and that the steps for certification are as follows:

- Obtain the GAPs guides at any of AGROCALIDAD's offices or on the website:
<http://www.Agrocalidad.gob.ec/direccion-de-inocuidad-de-alimentos/>
- Verifies that the farm complies with the requirements established by the GAP guidelines. If you need help for the implementation on the farm, you can get advice from certified technicians as implementers by AGROCALIDAD available on the website.
- Once you verify compliance, you can approach AGROCALIDAD offices nationwide and fill out the certification application.
- The AGROCALIDAD technicians will contact and coordinate a visit to the farm to verify compliance with the request.
- The certificate that lasts for three years will be granted and whose service is free for those who start the process.
- During this time, technical visits will be made to verify compliance.