

Trend Analysis of the *Passiflora maliformis* Productive Chain in Colombia

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Abstract: The present study presents an exercise of future trends of the productive chain of the *Passiflora maliformis*, generally known as cholupa using benchmarking as a methodological tool. The study was bibliographic, carried out through the analysis of specific literature on the subject using the data record sheet applied to books, articles, bulletins, magazines and newspapers that were used as sources to collect information. In this regard, aspects such as certified production, new fields of use for fruit, agrorobotic, denomination of origin, technologies applied to the agricultural sector, new markets, among others were identified.

Key words: *Passiflora maliformis*, trends, productive chain, articles, magazines, information

INTRODUCTION

In Colombia, *Passiflora maliformis* or cholupa has been cultivated for more than 30 years in some municipalities, mainly in the South of the country. Its production evolved in a positive way and in 2007 it was granted the seal of protected designation of origin, becoming an important product for the national economy.

The cultivation of cholupa has become a line of economic and social importance for being highly profitable and for generating rural jobs which can reach 648 wages per hectare during a 3 years cycle. The average yield is 8.39 tons/ha while maximum yields of up to 20 tons/ha have been reported, highly dependent on the agronomic management and genetic quality of the seed.

Tradition and empiricism in cultivation and production are factors that have primarily impeded the technological development of crops in Colombia. For example the preparation of the soils is limited to the weeding of the sowing area the use of seeds without any selection criteria and the maintenance of the sown areas. The complex series of processes of exchange or flow of materials and information that is established in the crops and within each organization or company as well as outside of it, entails implementing actions and studies that involve all the productive and commercial processes as well as relevant actors such as the suppliers and the clients in a frequent flow of information. This aims to

establish criteria and tools for decision making by turning sectors and organizations into systems that develop their activities efficiently and effectively.

Despite its importance the economic activity of cholupa does not have prospective studies or trends that allow producers and marketers to support decision making and their implications in the future. The success or failure of the production and commercialization activities of the productive associations and of the organizations currently depends on the tools used to project, design and establish their actions and how they are oriented towards the development and construction of the future in order to allow us to see, consider and face current challenges and changes to reach the ideal future.

With the analysis of trends in the economic activity of cholupa an analysis of the present and future dynamics on its productive and commercial dimensions is proposed, allowing the generation of a tool that will support the decision making of the fruit sector and especially, of the producers and marketers of tropical fruits, specifically cholupa.

In this regard, there is a promising future for the economic activity of cholupa given the environmental conditions of the country which requires studies that project the future of the business (Navia *et al.*, 2018a-c) with an inclusive entrepreneurial character (Murcia *et al.*, 2019).

Trend analysis has a set of very varied tools that include bibliometrics, scientometrics or patentometry, all quantitative analysis of scientific or technological

production. However, the present study focuses on a benchmarking analysis which until now has been known in Ibero-American countries as surveillance. Benchmarking is mainly used to analyze trends related to how to improve processes based on the selection of benchmarks or best practices, it mainly focuses on qualitative information and has been addressed in different environments, remaining homogeneous in its application (Navia *et al.*, 2018a-c; Garzon *et al.*, 2019).

MATERIALS AND METHODS

Design: Based on the proposed objective and considering the degree of depth of the approach to the phenomenon it is considered exploratory-descriptive. Likewise, it is of a bibliographic nature for it analyzes specific literature on the subject.

Instruments: In the present investigation, the data record form, applied to books, articles, bulletins, magazines and newspapers that were used as sources to collect data on the categories of interest was used as an instrument for collecting information. This instrument allowed the registration and identification of sources of information as well as the collection of data or evidence.

RESULTS AND DISCUSSION

Next, an analysis of the main tendencies, advantages and potential opportunities for the production and commercialization of the cholupa was carried out following the literature review and the knowledge of experiences developed in other countries around the world.

Certified production: The specialization of the international markets brought with it the growing need to guarantee the suitability of the products that enter these markets. Thus, the certifications such as the GLOBAL GAP (GLOBAL GAP it is a program and a global reference for Good Agricultural Practices (GAP) that is managed by the GLOBAL Secretariat GAP) are fundamental as a guarantee in all markets. These certifications favor the increase in sales prices in specialized markets.

The certifications become a passport to carry out business processes with international markets. The National Council of Passionists in a joint report to the Ministry of Agriculture and Rural Development in 2018, underlined that in the Andean region the process of certification of farms in the framework of the NTC 5400 standard has begun with the ICA. However, it is necessary to register the efficiency of agricultural inputs for the protection of the crop and the management of

phytosanitary problems (fungi, fly ovaries and viruses) in order to comply with the quality and safety standards required by international markets in the purchase of fresh fruit.

In this sense, among the requirements in terms of certifications to ensure commercial processes with the European Union there are two international certifications: the HCCAP standard which is required to enter processed fruit into the European market and the Global Gap certification for the export of fresh fruit.

Uses of the fruit: Cholupa has different uses and presentations: its main use is from its presentation in regional and national markets as fresh fruit, up to its presentation in drinks as simple juice or concentrate, lyophilized pulp, dessert and ice cream.

Its strong aroma and richness in vitamin C and minerals allow it to be used as a complement to multivitamin products and in the generation of new flavors in the juice and beverage industry. In addition to the pulp the leaves are used at the pharmaceutical level when they are prepared in infusion to alleviate ailments such as gastritis, anti-vomit and accelerator in dilation during childbirth.

On the other hand the seed has high contents of oils (28.3%) which can be used in the food industry for specialized cooking and in cosmetology. The plant due to the beauty of its flower and fragrance is used as an ornamental plant or for the production of perfumes.

Robots as an agricultural force by 2025: According to experts, agrorobotica will extend in up to 30% of the world's fields in 2025, a situation that will be combined with the increase in food demand for the more than 8,000 million people that are supposed to populate the Earth for that year.

The main novelties consist of robotic systems capable of automatically planting seeds and other systems designed to identify and eliminate weeds in different types of land, so that, technology contributes to the food demand for the coming years.

Thus, it is expected that robots will be capable of eliminating the grass mechanically and of making use of solar energy while applying herbicides in a controlled manner with millimetric calculations taking into account the characteristics of each forming plant. Said reality, meanwhile will allow reducing the physical risks in humans while at the same time the use of the necessary supplies for each plant will be maximized.

Appellation of origin: Among the advances to be highlighted by the guild of the passionflower sector, especially in the production of cholupa is obtaining the denomination of origin. In 2016 the Superintendence of Industry and Commerce handed over the denomination of

origin, opening the way to take advantage of one of the fruits of the Southern part of the country through the discovery of new uses and properties that position it in the national and international market.

Multispectral images for agricultural monitoring: In the country the Colombian corporation of agricultural research (Corpoica) promotes technology that allows more accurate monitoring for the development of agricultural crops as well as the prediction of yields closer to reality. This technology uses drones and is developing a system that captures and analyzes multispectral images. The images allow monitoring the affectations in the plant through the waves that emit the affected parts in the crops, achieving greater precision in the evaluation of the affectation of sowing and improving decision making.

Similarly, the most important in the implementation of these technologies is the efficiency that allows quick and accurate decisions for the management of crops and the meticulous treatment given to aerial images, since, the system performs the visual analysis and generates the estimate of the percentage of affected foliage in the crop, configuring itself as a support system for decision making with which strategies for its management can be proposed in an effective, ecological and economically viable way for the national producer.

Quality seeds: Corpoica is one of the national entities of science and technology responsible for the genetic improvement of plant material and production of high-quality seeds. As part of the research agenda macro projects have been developed in the networks of cocoa, fruit, livestock, minor species, vegetables, aromatic plants, roots, tubers and transients that have a scope in the different productive chains. These macro projects seek to improve productivity, safety and resistance to the most restrictive diseases in crops, taking advantage of available genetic resources and generating better agronomic management practices.

Certification of passionflower seeds: The national government and the regional governments carry out projects with the objective of characterizing and monitoring the biology of passionflower, determining its agronomic and nutritional component, analyzing its color, weight, shape, size, sweetness in Brix degrees and its different characteristics through tests specialized laboratory. The certification will ensure that the seed used for planting results in a consistent and equivalent crop, in addition to ensuring production is free of pests and diseases to obtain better crops and better income.

These projects reach an investment of around 2,800 million pesos in order to improve these species through the identification, production, conditioning and genetic

identity for obtaining fruits of high physiological, sanitary and physical quality. Part of the methodology used consists of a field inspection and a laboratory analysis to check the quality of the seeds from their origin, production and storage process, to their commercialization.

Research development: According to the information reported in the siembra platform, 463 research groups work on issues related to the agroindustrial sector, of which 76 (16.41%) have experience in passion plants. These groups are found in 16 departments: in the Andean region (9 departments), Caribbean region (4 departments) and Pacific region (3 departments). They are concentrated mainly in Valle del Cauca (15 groups), Bogota (13), Antioquia (10), Boyaca, (6), Cordoba (6), Cundinamarca (6) and Caldas (5). Of 37 entities to which the groups that have worked in passion flowers are affiliated the National University of Colombia is the one that gathers the largest number (15), followed by the Colombian Research Corporation.

Opening of international markets: Colombia is betting on the expansion of markets for agricultural products as a fundamental tool for sustainable rural development. In this context the Ministry of Agriculture and Rural Development, through the office of international affairs, accompanies the agricultural sectors in the management that requires the use of free trade agreements as well as the management for the eligibility of products with exporting potential generating credibility in the country's health system.

It also manages the linkage of the country's agricultural sector to the Organization for Economic Cooperation and Development (OECD) and safeguards its interests before the World Trade Organization (WTO). The Ministry of Agriculture and Rural Development seeks to strengthen international cooperation to complement national policies, plans, programs and projects for the benefit of development, a strategy that is important in the post-conflict context to maintain a stable and lasting peace.

TLC with the USA: The Colombia-United States treaty came into force in 2012. According to the report of the Ministry of Agriculture and Rural Development, exports from the Colombian agricultural and agroindustrial sector to the United States between November 2016 and November, 2017 increased 11.76%, increasing from USD 2,343-2,619 million during this period. This growth was mainly marked by sales of coffee, flowers, sugar and confectionery which accounted for 82.7% of the value of sales to that country. Non-traditional sub-sectors began to stand out due to their potential as is the case of fish, crustaceans and mollusks with exports that grew

by 13.3% in value, from USD 45.3-51.3 million. Within this group of products, exports of fresh or chilled trout, tilapia fillets and ornamental fish stand out for their dynamism. Other products that contributed to the increase of sectoral sales to the United States were vegetables, fruits, seeds and oleaginous fruits. In November 2017, Colombia sent the first shipment of 34 tons of Hass avocado to the United States, marking the beginning of exports of new products to that market, among which the potential for passion flowers could be highlighted.

Treaty with South Korea: The trade agreement between Colombia and South Korea came into force in 2016 with which 56% of agricultural products obtained tariff benefits within which 48% of the subheadings of the agricultural field were immediately accessible such as rabbit meat, chicken eggs, bulbs, cauliflowers, cabbages asparagus, apples, pears, green coffee and its derivatives, milk drinks, among others. With the opportunities that the treaty opened up the main aim is innovation the strengthening in the added value and the admissibility management. In order to achieve this, work was started within the framework of the sanitary and phytosanitary measures committee of the agreement, advancing in the identification of products of interest for each country. Colombia prioritized avocado, mango, cape gooseberry, passion fruit and pork.

The Pacific Alliance: In order to deepen the current conditions negotiated under the framework of the Trade Agreement of the Pacific Alliance through the inclusion of new markets the governments of Mexico, Chile, Peru and Colombia, according to the Ministry of Agriculture and Rural Development, began negotiations in the year 2017 as a block with the countries of Singapore, Canada, New Zealand and Australia. The objective of the negotiation for the countries of the region of which Colombia is part is to deepen the commercial ties within the alliance and enhance the possibilities of export, investment, cooperation and other disciplines that exist with these economies.

Final peace agreement in Colombia: The compromise in the final peace agreement in Colombia establishes that in order to end the conflict the countryside must be structurally transformed, creating welfare conditions for the rural population and thus helping to build a stable and lasting peace. To help the structural transformation of the field, international cooperation is considered an important factor as a mechanism to strengthen bilateral and multilateral relations in Colombia, through different types of cooperation such as financial, technical, food humanitarian, scientific and technological aid.

The Ministry of Agriculture and Rural Development has been strengthening its relations with traditional cooperators such as the United States, FAO the European Union the Netherlands, France, Japan and the World Bank, opening new cooperation agendas with cooperators such as Denmark, GIZ-Germany, Australia, China, French Development Agency (AFD), Argentina, Peru, Hungary and New Zealand. The purpose is to leverage technical and financial resources that contribute to the strengthening of chains such as cotton, cocoa, rice, coffee, Hass avocado, beef, pork, aquaculture and fishery, among others. Opportunities for cooperation have also been strengthened with actions that contribute to rural development (food security, family agriculture, rural women, rural youth, productive capacities) in the post-conflict context.

This contributes in an important way to solving factors such as tradition and empiricism which have largely impeded the technological development of communities in Colombia.

Ecological production: During 2017 there was an intention to update and modify the ecological production regulation adopted by Resolution 0187 of 2006 by issuing Resolution 199 of 2016 which partially modifies the regulation for primary production, processing, packaging, labeling, storage, certification, importation and commercialization of organic agricultural products adopted through Resolution 0187 of 2006. The main adjustments included in Resolution 199/2016 are the updating of the regulatory framework related to food, inputs and environment, the elimination of exceptions due on December 31, 2012, the extension of the scope of the regulation to allow the certification of seeds and reproductive plant material (not only food); and the updating of the provision on inputs allowed in organic production.

The Directorate of Innovation, Technological Development and Health Protection of the Ministry of Agriculture and Rural Development advanced the formulation of public policy guidelines in organic and agroecological agriculture in Colombia, 2017 which contains among other aspects the instruments of control of organic production and the instruments for promoting organic and agro-ecological production.

CONCLUSION

Once the process of benchmarking and analysis of trends is completed the main economic activity of cholupa is the production of certified fruits in order to achieve higher profits and trading margins, especially in international markets. Likewise, agrorobotics stands out as the application of robotic systems capable of automatic planting of seeds and other systems designed to identify and eliminate weeds in different types of land.

On the other hand, highlights such as the genetic improvement of plant material, related to improved and certified seeds for increased productivity of the sector, resulted in high crop yields and resistance to diseases and pests.

Finally, the fruit and its derivative products have a wide potential of commercialization in international markets such as the United States, Europe and Asia as a consequence of the free trade agreements signed by the country.

REFERENCES

- Garzon, A.O., P.R.B. Maluche, A.J.M. Navia and Q.A. Bonilla, 2019. Technological surveillance for the identification of business models for internet of things IoT. *J. Eng. Appl. Sci.*, 14: 6406-6414.
- Murcia, E.T., R. Mosquera and J.M. Andrade, 2019. Entrepreneurship as a tool for productive inclusion: Analysis of the case of Colombia. *TEM. J.*, 8: 195-200.
- Navia, J.M.A., E.R. Plazas and A.O. Garzon, 2018a. [Technological watch applied to the production chain of cocoa (In Spanish)]. *Espacios Mag.*, 39: 1-12.
- Navia, J.M.A., E.R. Plazas, J.D.C. Ramirez, A. Ligia, L.O.P.E.Z. Rodriguez, H.S. Pimentel and J.A.M. Gallego, 2018c. [Scientific and technological advances in cannabis in the medical field (In Spanish)]. *Espacios*, Vol. 39, No. 39.
- Navia, J.M.A., J. Castaneda Munoz and E.R. Ramirez Plazas, 2018b. [Regional planning in Southern Colombia: A contribution from the territorial prospect (In Spanish)]. *Espacios*, Vol. 39, No. 24.