STATE OF THE ART OF FLORICULTURE IN ECUADOR: HISTORICAL AND CURRENT ECONOMIC CONTEXT, GENETIC IMPROVEMENT AND CARBON FOOTPRINT

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ABSTRACT

The purpose of this review is to carry out an analysis of the Ecuadorian flower sector and its current status, since in recent decades it has developed in an accelerated manner and the knowledge that currently exists on this activity is basically economic figures based on the exported product tons and markets exportation. The beginnings of flower companies in Ecuador occurred in the 1980s, concentrating to the present day in the Sierra region. Since then, the flower growing sector has been progressively implementing planting of new varieties of flowers, applying greenhouse cultivation and new agricultural methods and research, which allowed it to stand out internationally in the 1990s. Its incomparable geographical situation, climatic conditions and mega diversity have allowed Ecuador to generate products of the highest quality, which represent an important source of income for the country economy. In recent years, taking into account, the quality and importance of generating environmentally friendly production and environmental responsibility of consumers tools such as the carbon footprint have emerged that allow companies to see different objectives of production, to gain competitive advantages, to have better risk management and to give added value to their products.

Keywords: Production, flowers, horticulture, decade, greenhouse.

RESUMEN

La presente revisión tiene como propósito realizar un análisis del sector floricultor ecuatoriano y su actualidad, ya que en las últimas décadas se ha desarrollado de una manera acelerada y los conocimientos que existen actualmente sobre esta actividad son básicamente cifras económicas basadas en las toneladas exportadas y mercados de exportación. Los inicios de las empresas florícolas en el Ecuador se dan en la década de los 80, concentrándose hasta la actualidad en la región sierra. Desde entonces el sector floricultor ha venido implementando de manera progresiva siembras de nuevas variedades de flores, aplicando el cultivo en invernaderos y nuevos métodos e investigaciones agrícolas, lo que le permitió despuntar a nivel internacional en la década de los 90. Su incomparable situación geográfica, condiciones climáticas y su mega diversidad han permitido que el Ecuador genere productos de la más alta calidad, mismos que representan una fuente importante de ingresos para la economía. En los últimos años teniendo en cuenta la calidad y la importancia por generar producción amigable con el medio ambiente y la responsabilidad ambiental de los consumidores, surgen herramientas como la Huella de Carbono que permiten a las compañías ver de diferentes objetivos la producción, ganar ventajas competitivas, un mejor manejo de riesgos y dar un valor agregado a sus productos.

Palabras claves: Producción, flores, horticultura, década, invernadero.

INTRODUCTION

Floriculture, as its name indicates, is oriented to the cultivation of flowers and plants for decorative purpose, but not for food. It is a branch within the discipline of horticulture (Colvinpenia, 2017). As Ruiz (2017) indicated, it is a broad area of knowledge that encompasses various activities such as the production of garden plants, production and marketing of cut flowers, landscaping and interior decoration. According to Rae (2020), where high

levels of labor and capital are used in relation to the area of used land, it is considered as a horticultural or intensive production activity. Another characteristic that makes it intensive is that a permanent use of the land is sought, unlike extensive productions. (Ruiz, 2017).

Ecuador is a country located on the equinoctial line with great potential for the development of the agricultural and agribusiness sector (Gómez & Egas, 2014). This country has natural characteristics that give it advantages in the production of certain goods such as banana, shrimp, cocoa and flowers, among others for which it has been internationally characterized. Ecuadorian floriculture is in the second place among non-traditional export products, in this way, Ecuador is recognized worldwide for being a biodiverse country as it has a variety of microclimates suitable for production of flowers, which are among the best in the world because of their quality and exclusive beauty (thick, long stems, large buttons, bright colors, and great durability) (Robalino, 2019).

As stated by Cabezas (2017), our country shows necessary and suitable conditions that allow it to show an excellent raw material. The excellent quality of the products has earned them significantly wide acceptance in international markets. As Castro (2019) indicated, the productive matrix still depends mainly on the export of oil, bananas, tuna, shrimp and flowers. Now, the idea is that all these products gradually acquire added value to obtain greater profit.

Considering the competitive advantages that Ecuador has to have high quality flowers, the industry sees the need to develop changes in its structure, systems and strategies so that it continues to be a profitable business (Paredes, 2019).

The purpose of this review is to carry out an analysis of the Ecuadorian floriculture sector and its current status, since in recent decades it has developed in an accelerated manner, where the knowledge that currently exists about this activity is basically economic figures based on exported tons and export markets.

HISTORICAL CONTEXT OF THE ECUADORIAN FLORICULTURE SECTOR AND PRODUCTION AREAS IN ECUADOR

The floriculture sector is one of the strongest industries in many developed and developing countries. This industry began at the end of the 19th century with the production and cultivation of tropical flowers, summer flowers, roses and other flowers (**Figure 1**), emphasizing that the flowers that are most welcomed or most in-demand worldwide are roses (Velez, 2016).

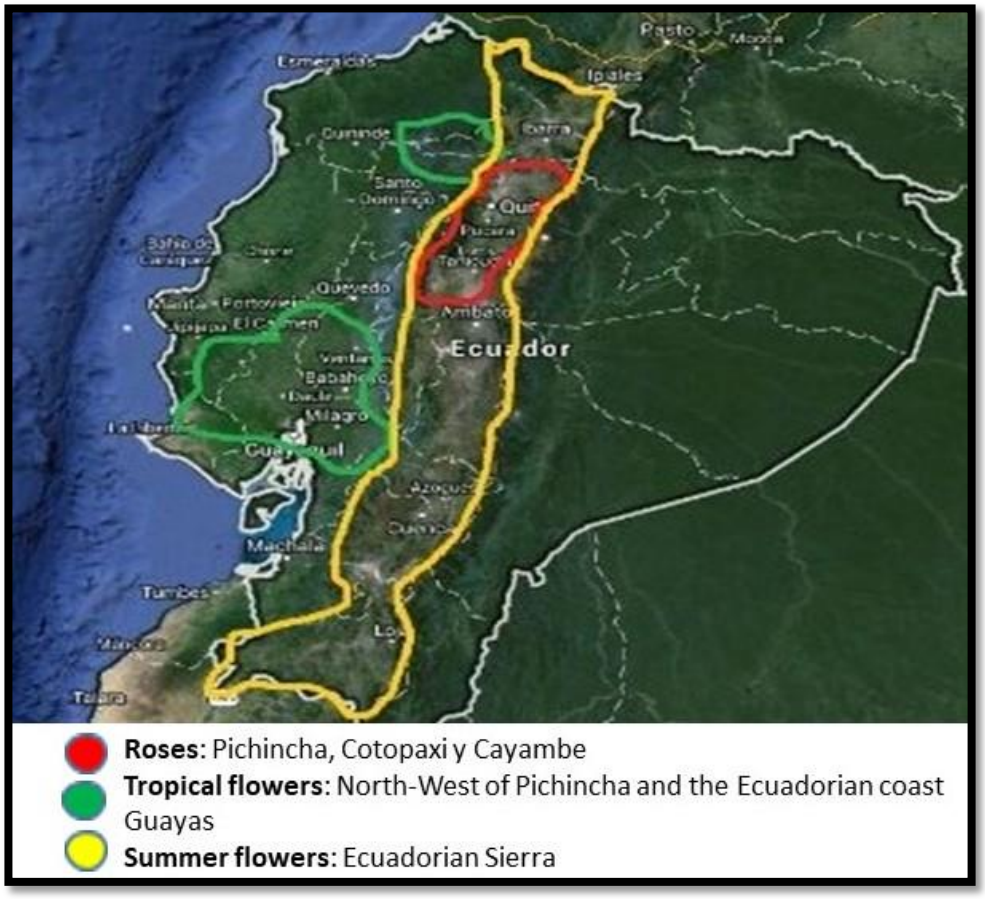

Figure 1. Geographical location of the floricultural sector in EcuadorSource: Authors.

As indicated by Macias & Villalta (2015), Ecuadorian flowers are grown at altitudes ranging from 2,200 to 2,700 meters above sea level, which allows for better harvests in shorter periods, and the number of hours, i.e. 12 hours, of light is constant, from 6:00 to 18:00. Warm days without sudden changes, cold nights, pure water, radiant sun and 12 hours of sunlight per day throughout the year allow to produce flowers with excellent characteristics.

In Ecuador, the cultivation of flowers began in the 70s, but after those years it stagnated a bit due to several inconveniences, among them, a labor protest, which caused the production to move to Colombia. However, it is worthy to mention that flower production has grown from the second half of the 80s until Ecuador became the second exporter in South America, following Colombia (Villacres, 2011). Exporting floriculture started in the 80's, with 2 hectares of roses. According to data from the National Association of Flower Producers and Exporters - Expoflores, the greatest expansion occurred in the Tabacundo and Cayambe sectors, because of their ideal agrological conditions, extending along the inter-Andean alley, mainly in the provinces of Cotopaxi, Imbabura, Carchi, and Azuay (**Figure 2**). (Bucheli & Velasquez, 2010). The first steps were difficult, maintaining the plantations and finding profitable markets were practically impossible and obtaining the necessary inputs for adequate production and the marketing process faced great difficulties. It was only when the business proved its potential in the mid-1990s, that interest in floriculture grew and necessary infrastructure and logistics were developed. Then, the 30 plantations that existed in 1990 multiplied rapidly and, 10 years later, 350 flower plantations could be counted. This was achieved thanks to the introduction into new markets, the same ones that were not exploited in the first phase (Prado, 2005). The constant development of floricultural activity over 17 years allowed the incorporation of state-of-the-art technology andtraining of qualified labor (Bravo & Flores 2007). Ecuadorian floriculture has unique characteristics that make it a top-quality product in international "Premium" markets. Because of its qualities, Ecuadorian flowers are known worldwide, which makes it an icon of the country, since it is exported to a large part of the world (Pullas, 2014).

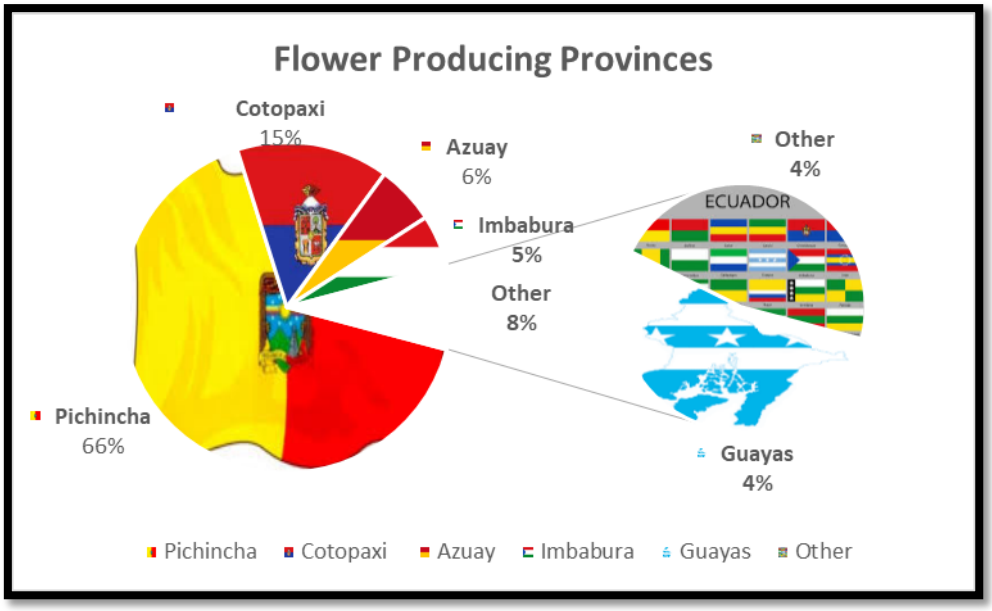

Figure 2. Distribution by provinces of the area cultivated with flowers. Taken from Montana, 2019.

CURRENT NATIONAL CONTEXT

Ecuadorian floriculture is an industry that generates a high degree of dynamism, but with less profitability and greater risk. Changes and trends in the world market and strengthening its competitors cause Ecuador to be impacted in its competitiveness(Paredes, 2019). In recent years, one of the sectors that have achieved greater growth is the floriculture, recognized in the world for its peculiar and unique characteristics; highlighting its large buttons (buds), long stems and its wide range of colors in addition to its great durability (**Figure 3**) (Robalino, 2019). Over the years, there is a growing production of flowers. The country has 4,200 hectares of flower cultivation, in more than 739 flower-producing farms, which 592 farms are registered in Agrocalidad, 147 farms are not registered, and 218 farms are unionized in the Association of Producers and Exporters of Flowers (Expoflores). This sector becomes one of the most relevant to the country's economy, generating 50,000 direct jobs and more than 110,000 direct and indirect jobs, with an average of 11 people per hectare, in which

women are about 51%, highlighting the provinces of the Ecuadorian Andes (Guerra, 2012; Expoflores, 2015; Proecuador, 2016 and Haro & Borsic, 2019). The floriculture sector has grown in a consistent way made up of three main actors: producers, wholesalers and retailers who open their field abroad (Poveda et al., 2017).

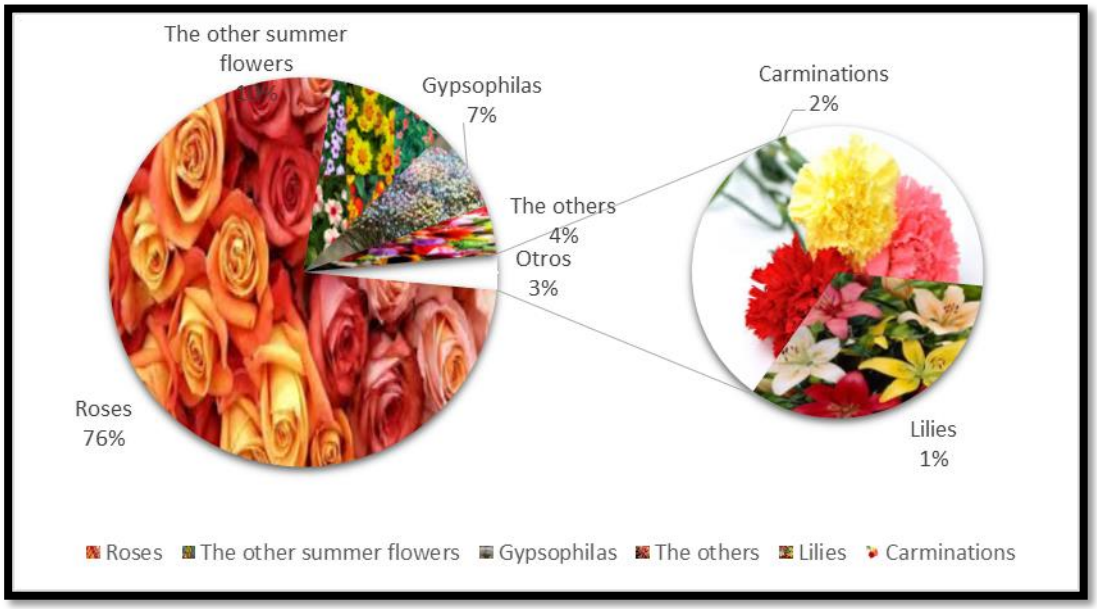

Figure 3. Main export flowers. Taken from Expoflores 2018.

The conquest of new markets, constant development of floriculture sector and ability to trade goods and services make Ecuador a more competitive country (Encalada & Crespo 2017). Exports of Ecuadorian flowers have grown significantly, currently reaching 120 destinations throughout the world. The main destinations for Ecuadorian flowers are: United States (40%), Russia (25%), Holland (9%), Italy (4%), Canada (3%), Ukraine (3%) and Spain (2%) (**Figure 4**) (Izquierdo et al., 2018).

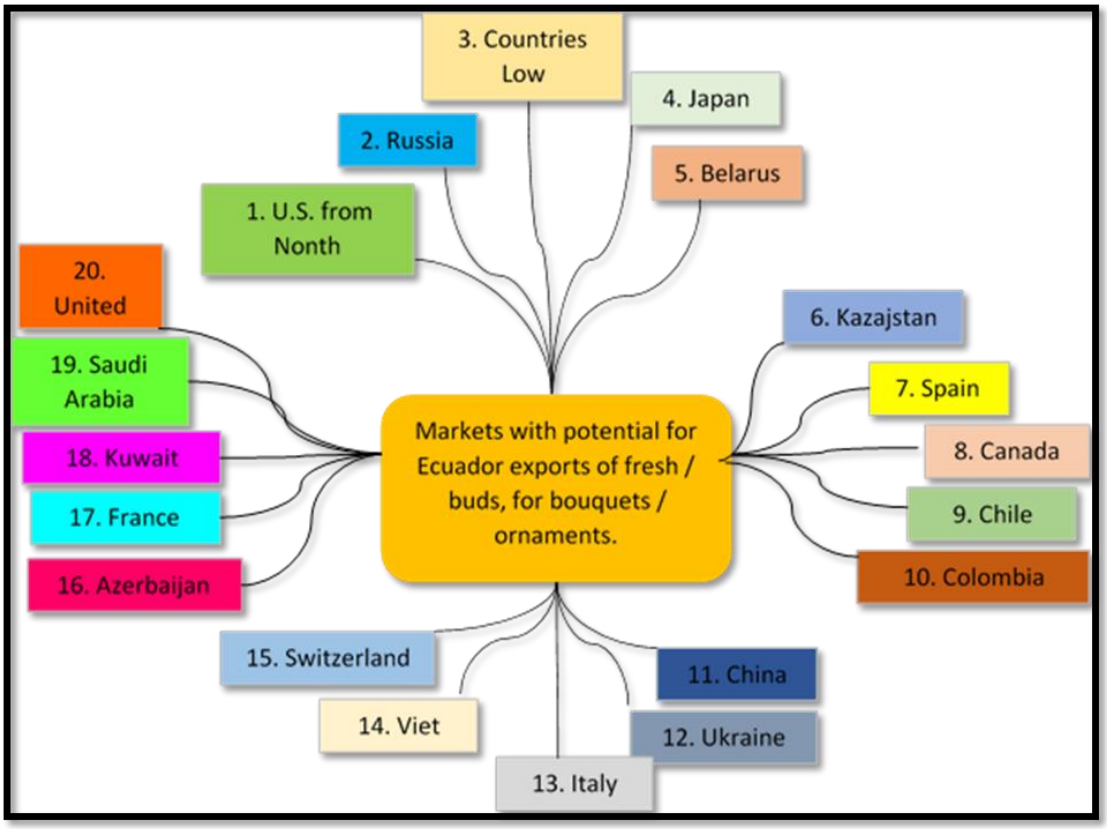

Figure 4. Ecuadorian flower export markets. Taken from Haro & Borsic, 2019.

According to data from the Central Bank of Ecuador (BCE), for the year 2018, Ecuadorian flower exports were 835.24 milliondolars. Martínez (2018) stated that the flower industry in the country is an economic activity that generates 1,200 million dolars per year. The Valentine's Day party represents 30% total annual sales of this sector (Telegrafo., 2019). The Ecuadorian flower industry contributes around 10% agricultural Gross Domestic Product (**Figure 5**) (Cluster, 2017).

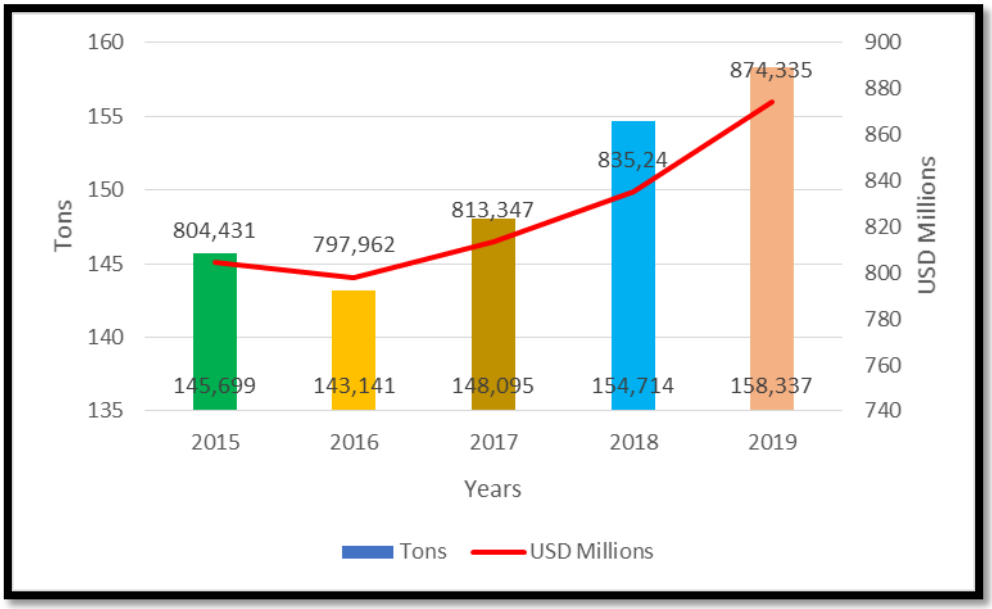

Figure 5. Export data for the last 5 years of Ecuadorian flowers. Taken from Expoflores 2019.

ORGANIZATION OF FLOWER PRODUCERS

The first steps taken by the Association of Producers and Exporters of Flowers of Ecuador was to obtain the approval of its Statutes by the Ministry of Agriculture and Livestock (MAG), and resources from the National Financial Corporation (CFN). Once the requirements were presented to the MAG, the association was registered in the General Registry of Associations on November 22nd, 1984 (**Figure 6**) (Bravo & Flores, 2007).

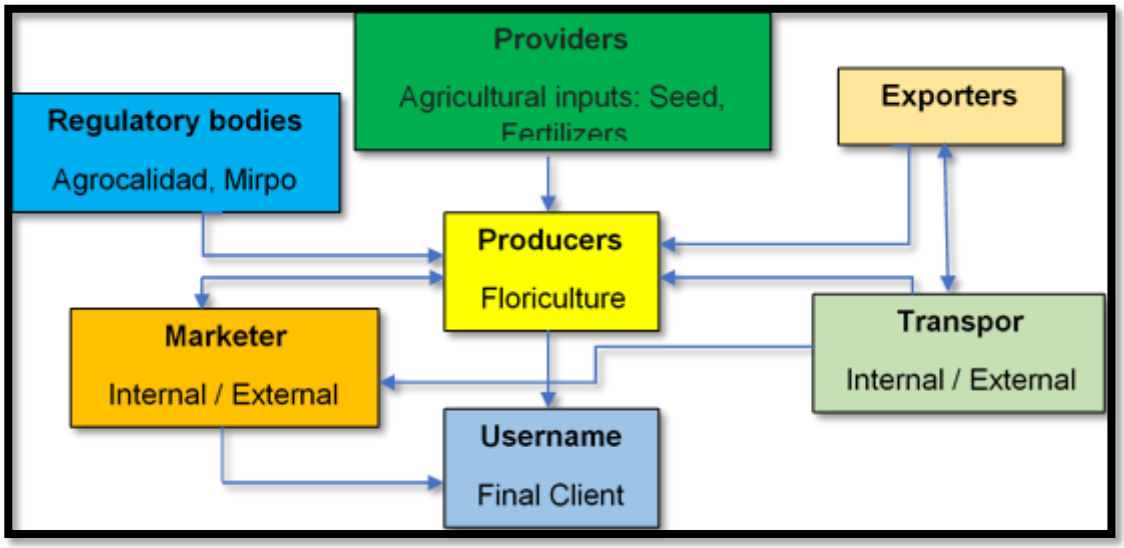

Figure 6. Actors of the Floriculture sector. Taken from Yépez, 2017.

According to Proecuador (2016), Ecuador is characterized by having a unique commercial strategy as floriculturists, that is: a high number of producers and small farms that produce more than 600 varieties (more than double its competitors) with an average of 57 varieties per farm. Martinez (2018) mentioned that the main international competitors produce few varieties in large land areas, so that productivity is what sets costs and competitive prices. Additionally, many producers are venturing into the production of preserved or eternalized flowers that

are in greater demand in Asia.

As indicated by INEC (2001), floricultural production in the country is also divided according to the size of farms. In the country, the majority of producers are small farms that produce in lands with an average of 6 hectares, the medium ones that represent 28% have an average land production of 13 hectares; and the large ones that are 10% of the total of the farms have in production around 37 hectares. The flower producing provinces have been benefited from trade flows that allow a positive variation in annual employment rates, which represents a constant incentive in the local market to continue producing flowers with a significant level of demand, thanks to the climate situation, which is the most important factor for more and better production (**Table 1**) (Espinoza, 2019).

Table 1. Distribution of the size of flower farms in Ecuador. Taken from Paredes 2019

Farms Size	Distribution
Big (> 30 hectares)	10%
Median	28%
Small (< 10 hectares)	62%

GENETIC IMPROVEMENT: TECHNOLOGY AND INNOVATIONS

For about 20 years, Ecuador has had research laboratories where new varieties are developed using tools such as cell and tissue culture techniques, biotechnological micropropagation, *in vitro* germplasm conservation, among others, seeking to implement technological efforts in irrigation system, pest control, temperature management in greenhouses, quality control and greenhouse management (Cabezas, 2017). As expressed by Rule (2017), the breeding companies known as Breeders are those who through research and genetic crosses generate new varieties of flowers. The intention is that the developed varieties are attractive to the market and producers, either due to the characteristics of flower, productivity, resistance to diseases and pests, low susceptibility to transport, etc. (**Table 2**).

One of the most modern biotechnological techniques is genetic editing (likeCRISPR/Cas9), which could be used to improve flowers, and roses in particular, and which has already been put into practice in other countries for roses. This technique consists of adding, removing or changing certain DNA fragments in order to alter their sequence in a more precise way, and, consequently, change the characteristics of an organism (Marfany, 2019). The CRISPR-Cas9 system is a plant breeding innovation that uses site-directed nucleases to target and modify DNA with a great accuracy. A Japanese research group succeeded in altering the colors of a famous Japanese flower called "morning glory" or "Japanese morning glory" (*Ipomoea nil* or *Pharbitis nil*) with a change from purple to white, silencing a single gene with the CRISPR technique. This new technique would allow this type of improvement,a n d could open a wide range to start other types of studies, such as improved plants against the increase and decrease of temperature, resistance to pests and diseases,among other desired characteristics, as it is the case with the famous and controversial transgenic crops (Watanabe et al., 2017). On the other hand, in the floricultural sector, there are many investigations in process and other activities that have been developed over time, which has served to replace technologies or improve processes in recent years (Gómez & Egas, 2014).

According to Toaquiza (2017), the use of state-of-the-art greenhouses and irrigation systems have placed Ecuador among the main innovative countries in the field of flower production. Producers continuously receive advice and training to improve production and quality, which helps to generate innovative practices. For example, varieties of roses are being developed, edible organic flowers are being produced, and an Ecuadorian environmental label called Florecuador has been created for crop management and quality.

CARBON FOOTPRINT IN ROSE PRODUCTION

Greenhouse gas (GHG) emissions and their possible effects on the environment have become an important national and international challenge, one of the main concerns is related to climate change (CC) (Paliz, 2019), since based on the Scripps Institution of Oceanography (2020), the concentration of carbon dioxide (CO2) in the atmosphere exceeded the barrier of 417 ppm. This 2020 maximum value was 5.9 ppm higher than the peak of 411.3 ppm reached in May 2018. Although, the cultivation of roses is an engine of economic development and generates significant financial benefits, it requires more than 80 chemical inputs; therefore, it has high environmental impacts (Accion E, 2000) (**Figure 7**). As stated by the IPCC (2014), the Intergovernmental Panel on Climate Change (IPCC) establishes that the agriculture, forestry and other land use sectors are responsible for around 10 to 12 GtCO2eq / year of anthropogenic emissions of net GHG. The carbon footprint of rose cultivation is great, mainly due to the high use of agrochemicals andthe energy and water requirements, thus contributing to the negative effects of climate change.

Table 2. Varieties of roses from Ecuador

Variety	Characteristics	Flower
Akito	Rose with pure white petals, that will leave you impressed. Itis desired for its elegance and glamor, perfect for any special occasion. Features: Button Size 3-4 cm; Stem length 40-70 cm; Vase life 10-12 days; Number of petals 35.	
Creme de la Creme	Soft creamy pink, exclusive and elegant. Produced in Ecuador and Colombia, it is characterized by beauty and inspiration from the ancient golden age. Features: button size5.6-6.6cm; stem length 40-60 cm vase life 12-15 days; number of petals 50.	
Brighton	This pink is beautiful like the sun that illuminates every day with its rays. Bright yellow in color and the shape of its corollas that looks like a silk ribbon spiral. Features: button size 5 cm; stem length 40-70 cm; vase life 12-14 days.	
Deep Purple	Its deep purple color with white undertones, conveys a feeling of royalty and symbolizes the feeling of love at first sight. This Ecuadorian rose is very striking, it has slightly fuchsia petals on the edge that give way to a lilac rose to lavender in April. Feature: button size 5-6cm; stem length 50-80 cm; vase life 10-12 days; number of petals 40.	
Explorer	Red flower with strong personality, the color of its petals seems like velvet, it is an intense crimson that shades out a darker tone. This Ecuadorian rose is one of the largest roses on the market. Features: button size 6.5 cm; stem length 60-90 cm; vase life 10-12 days; number of petals 43.	
Kahala	Ecuadorian Champagne Rose - soft cream in a warm, delicate shade of peach powder. Glows when paired with orange gradations and fall leaves. Features: button size 5.5 cm; stem length 40-70 cm; vase life 14 days; number of petals 40.	
Mother of Pearl	This Ecuadorian rose with a large button, with delicate and warm tons of soft pale pink and texture that evokes the magicand brilliance of a pearl necklace. Its cocoon is a cascade of petals that are like velvet. Features: Button size 6 cm; stem length 50-80 cm; vase life 12-14 days; number of petals 45.	
O´Hara	Delicate and fragrant pale color garden rose. This rose portrays unsurpassed romance and luxury. Its multiple layers of soft pink petals bloom in an incredible way, creating a wonderful and romantic atmosphere. Characteristics: stem length 60-80 cm; button size 6.5 cm; petal numbers 60-65 and vase life 14 days.	
Queenbery	This Rose is deep pink in color, its vibrant petals make the likeness of a silk scarf. This rose has a color that deserves a special mention. Characteristics: stem length 50-60 cm; button size 5.5-6.0 cm; number of petals 39 and vase life 12 days.	
Orange Crush	Pink that expresses admiration and attraction, with a warm and vibrant tone symbolizes desire and enthusiasm. Features:button size 5.5-6cm; stem length 40-70 cm; vase life 10-12 days and number of petals 30-35.	
Wasabi	Ecuadorian rose of green color with curly opening, this rose exhibits a corolla of delicate green tones in itself this rose isperfect for a young and modern woman. Features: button size 5.5 cm; stem length 50-80 cm; vase life 15-18 days; numberof petals 55.	
Amnesia	This rose is not produced in large quantities, so it is difficult to find it since the demand exceeds the supply, it is aged lavender. Produced in Ecuador, it is a rose with a medium-sized bud opens beautifully, perfect to combine with other flowers or display on its own. Features: button size 4.5-5.5cm; stem length 50-60 cm; Vase life time 12-14 days and number of petals 38.	

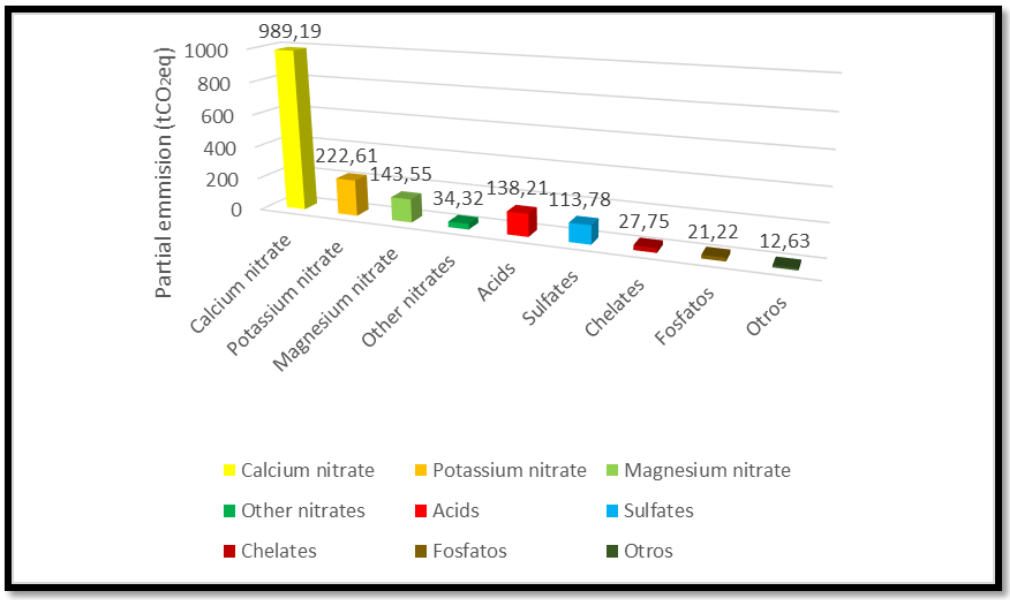

Figure 7. GHG emissions from the agricultural products or fertilizers most used in rose cultivation. Taken from (Guallasamin & Simon-Baile, 2018).

The sale of roses in international markets currently requires obtaining environmental certifications and labels such as the calculation of carbon footprint, a mechanism for competitive positioning of products in the international arena. For this, immediate progress is required in the quantification processes of GHG emissions and in reducing the effects of climatechange. However, Ecuador lacks up-to-date calculations on the carbon footprint of rose cultivation and country-specific emission factors, thus the measures to reduce emissions to production cannot be specific or expressly intended for the main sources of production issue. This represents a risk for the export of Ecuadorian roses because it could cause a loss of competitiveness in international markets (Guallasamin & Simon-Baile, 2018).

CONCLUSIONS

The Ecuadorian economy has historically been very dependent on the agricultural sector. Initially, cocoa was the leading product, then bananas, and currently other products have been added, such as flowers, which have taken center stage in exports. The climatological and geographical factors of Ecuador have had a great importance for the development and growth of the country's floricultural exports, obtaining a quality product that satisfies the demandof international market. The production chain requires a lot of technologies in the farms, care and knowledge about processes. Since the development and production of local varieties depend directly on the treatment given to the crops, the economic and social importance of floriculture is essential when it comes to generating resources for the country. The generation of employment is so important that 60% workforce are women, and it is estimated that it indirectly employs more than 100,000 people. The National Association of Flower Producers and Exporters of Ecuador (Expoflores) must have a leadership role for the sector, being an entity that has the authority to pressure government sectors by supporting the management of the industry, streamlining and improving export processes. The evolution of the floricultural sector in terms of varieties and innovations must be taken advantage of and this provides added value to the merchandise and the demanding market.

REFERENCES

Accion, E. (2000). Caso 1: La industria de las flores. Las flores del mal: las floricultoras y su crecimiento acelerado. Alerta N° 88., Pp 11. http://historic.edualter.org/material/sobirania/enlace6.pdf

Bravo, T. M., & Flores, S. S. (2007). Incidencia de la Produccion de rosas en el sector de Cayambe periodo 2000-2005. *Tesis de grado para la obtencion del titulo de Economista. Universidad Laica Vicente Rocafuerte de Guayaquil, Facultad de Ciencias Economicas. Guayaquil-Ecuador.*, Pp. 107. http://repositorio.ulvr.edu.ec/handle/44000/1770

Bucheli, L. V., & Velásquez, P. H. (2010). *Castrato de flores de Exportación en funciónde su Rentabilidad y uso de suelo.* Quito-Ecuador: SENACYT-MAGAP-SIGAGRO. http://sinagap.agricultura.gob.ec/phocadownloadpap/modulos/censo_encuestas/censo_floricola/censo_floricola.pdf.

Cabezas, R. D. (2017). Exportaciones de flores hacia los Estados Unidos. *Tesis de grado para la obtención del*

título de Tecnóloga en Exportaciones e Importaciones, Universidad de las Américas, Facultad de Ciencias Económicas y Administrativas, Quito-Ecuador, Pp. 1-63. http://dspace.udla.edu.ec/bitstream/33000/7923/1/UDLA-EC-TTEI-2017-26.pdf

Castro, C. G. (2019). Análisis de la oferta exportable Ecuatoriana en el mercado de Chile en base al acuerdo de complementación Económica ACE N° 65 y la Competitividad en la Comunidad Andina CAN. *Tesis de grado previa a la obtención del título de Ingeniería en Comercio Exterior y Negociación Comercial Internacional, Universidad Politécnica Estatal del Carchi, Facultad de Comercio Internacional, Integración, Administración y Económica Empresarial.*, Pp. 1-146. http://repositorio.upec.edu.ec/handle/123456789/718.

Cluster, F. (13 de Noviembre de 2017). *Nuevos aranceles pueden complicar a floricultores en Ecuador*. Obtenido de http://flor.ebizor.com/aranceles-y-los-floricultores-en-ecuador/

Colvinpenia. (28 de Agosto de 2017). *La floricultura, El arte de cultivar plantas y flores.* Obtenido de https://www.thecolvinco.com/es/blog/floricultura-el-arte-de-cultivar-flores/

Encalada, L., & Crespo, A. (2017). Análisis de las exportaciones de flores ecuatorianas hacia el mercado Chino período 2010-2015. *Tesis previa a la obtención del título de Ingeniero en Gestión Empresarial Internacional, Universidad Católica de Santiago de Guayaquil, Facultad de Ciencias Económicas y Administrativas, Guayaquil-Ecuador*, Pp. 62. http://repositorio.ucsg.edu.ec/handle/3317/7767

Espinoza, P. K. (2019). Importancia del sector floricultor en el desarrollo económico y social del Ecuador, período 2013-2017. *Tesis de Grado previo a la obtención del título de Economista, Universidad de Guayaquil, Facultad de Ciencias Económicas Guayaquil-Ecuador.*, Pp. 86. http://repositorio.ug.edu.ec/handle/redug/40550#:~:text=A%20partir%20de%20los%20resultados,y%20dinamiza%20el%20crecimiento%20econ%C3%B3mico

Expoflores. (2015). *Exportaciones totales de flores a la Unión Europea; Informe Anual de Exportaciones de flores.* Obtenido de Asociación de Productores y Exportadores de flores. https://sway.office.com/arNl7HuKwaUWESr2.

Gómez, R. C., & Egas, C. A. (2014). Analisis historico del sector floricola en el Ecuador y estudio del mercado para determinar su situacion actual. *Tesis de grado para la obtencion del titulo de Licenciado en Administracion de Empresas, Universidad San Francisco de Quito, Quito-Ecuador*, Pp. 1-102, https://repositorio.usfq.edu.ec/bitstream/23000/3323/1/110952.pdf.

Guallasamin, C. K., & Simon-Baile, D. (2018). Huella de carbono del cultivo de rosas en Ecuador comparando dos metodologías: GHG Protocolo vs. PAS 2050. *Revista Latinoamericana de Estudios Socioambientales, Letras Verdes*, N° 24, Pp. 27-56. https://doi.org/10.17141/letrasverdes.24.2018.3091

Guerra, B. M. (2012). Cayambe: entre la agro empresa y la agrobiodiversidad. *Tesispara obtener el título de Maestría en Estudios Socioambientales, de FLACSO-Sede Ecuador*, Pp. 170. https://biblio.flacsoandes.edu.ec/shared/biblio_view.php?bibid=126750&tab=opac

Haro, P., & Borsic, Z. (2019). Análisis prospectivo y comparativo de la exportación de las Gypsophilas frente a las Rosas. *Relaciones Internacionales, Yura*, N° 19, Pp21-48. http://world_business.espe.edu.ec/wpcontent/uploads/2019/06/19.2-An%C3%A1lisis-prospectivo-y-comparativo-de-la exportaci%C3%B3n-de-Gypsophilias.pdf.

INEC Instituto Nacional de Estadísticas y Censos. (23 de Abril de 2001). *Boletín Agropecuario Mensual. Producto del mes: Flores y Piña.* Obtenido de www.ecuadorencifra.com/cifras-inec/pdfs/boletinag06.pdf.

IPCC. (2014). *Cambio Climático 2014- Mitigación del Cambio Climático*. Obtenido de https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/WG3AR5_SPM_brochure_ es.pdf.

Izquierdo, G. D., Mosquera, T. M., Roble, Q. D., & Rosales, C. F. (2018). Competitividad en las exportaciones florícolas del Ecuador. *Ciencia Digital*, Vol2, N° 2, Pp. 320-333. DOI: https://doi.org/10.33262/cienciadigital.v2i2.95

Macias, Z. M., & Villalta, T. E. (2015). Factibilidad de una integracion Ecuatoriana-Colombiana para la comercializacion de flores dirigidas al mercado ruso. *Tesis de grado previo al titulo de Ingenieria en Comercio y Finanzas Internacionales Bilingue, Universidad Catolica de Santiago de Guayaquil, Facultad de Especialidades Empresariales, Guayaquil-Ecuador*, Pp.112. http://repositorio.ucsg.edu.ec/handle/3317/4902

Marfany, G. (2019). Interrogantes y retos actuales de la edición genética. *Revista de Bioética y Derecho, www.bioeticayderecho.ub.edu - ISSN 1886-5887*, N° 47, Pp 17-31.

Martinez, A. (2018). *Evolución del sector Florícola Ecuatoriano; Conferencia en Universidad San Francisco de Quito.* Quito – Ecuador.

Oceanography, S. I. (14 de Mayo de 2020). *La Curva de Keeling*. Obtenido de Instituto de Oceanografía Scripps

en UC San Diego: https://scripps.ucsd.edu/programs/keelingcurve/2019/06/04/carbon-dioxide-level s-hit-record-peak-in-may/

Paliz, B. C. (2019). Huella de Carbono de la finca María Verónica de Industria lácteas Toni. *Tesis de grado previo a la obtención del título de Ingeniería en Ambiente y Desarrollo en el grado Académico de Licenciatura, Escuela Agrícola Panamericana, Zamorano Honduras*, Pp. 26. https://bdigital.zamorano.edu/bitstream/11036/6585/1/IAD-2019-T012.pdf

Paredes, B. M. (2019). Posicionamiento de los floricultores ecuatorianos, frente a los cambios y tendencias del mercado Ruso, Americano, Europeo y Chino. *Tesis de Magister en Administración de Empresas, Universidad Internacional del Ecuador, Facultad de Ciencias Administrativas y Económicas, Quito-Ecuador*, Pp. 1-82. https://repositorio.uide.edu.ec/handle/37000/3834

Poveda, B. G., Roggiero, M. Y., Morales, R. G., & Holguin, V. K. (2017). Evolución delos productores Ecuatorianos como flores y materia prima hacia Japón. *Revista Observatorio Iberoamericano de la Economía y la Sociedad del Japón; http://www.eumed.net/rev/japon/29/exportacion.html*, Vol 9, N° 29, Pp 1-36.

Prado, J. J. (2005). Flores en el Ecuador Pasado y Futuro. *Revista Perspectiva*, Pp. 1-5. https://issuu.com/ideperspectiva/docs/revista_perspectiva_febrero_2005.

Pro ecuador. (2016). *Instituto de Promoción de Exportaciones e Inversión*. Análisis sectorial rosas frescas 2016. Recuperado de http://www.proecuador.gob.ec/pubs/analisis-sectorial-de-rosas-frescas/

Pullas, E. A. (2014). Vistazo a un país sector florícola. *Tesis de grado previo a la obtención del título de Economista y Finanzas Internacionales, Pontifica Universidad Católica del Ecuador, Facultad de Economia y Finanzas,Quito-Ecuador*, Pp.102.

Rae. (23 de Abril de 2020). *Boletín Agrario*. Obtenido de https://boletinagrario.com/ap-6, floricultura, 418.html

Robalino, L. M. (2019). Análisis comparativo de las estrategias propuestas en el acuerdo comercial de partes entre Ecuador y la Unión Europea, enfocado al sector exportador de flores, provincia de Pichincha período 2015-2017. *Tesis de Grado previa al obtener del título de Ingeniero Comercial, Universidad Politécnica Salesiana sede Quito, Facultad de Administración de Empresas, Quito-Ecuador.*, Pp. 1-39. https://dspace.ups.edu.ec/bitstream/123456789/16890/1/UPS-QT13735.pdf

Ruiz, L. (16 de Enero de 2017). *Que es la Floricultura*. Obtenido de https://hogar.uncomo.com/articulo/que-es-la-floricultura-44042.html

Rule, D. (2017). Posicionamiento del Ecuador en la floricultura Internacional. *Conferencia del gremio de floricultores Ecuatorianos - Expo flores.*Quito-Ecuador.

Telegrafo., E. (6 de Febrero de 2019). Se espera un crecimiento en las exportaciones de flores. *www.eltelegrafo.com.ec*, págs. 3-4.

Toaquiza, V. G. (2017). Análisis y Evaluación de la producción de rosas, en la parroquia Mulalo del Cantón Latacunga, Prov. de Cotopaxi, en el marco de la transformación de la matriz productiva, con fines de exportación durante el periodo 2009-2015. *Tesis de grado previo a la obtención del título de Economista, Universidad Central del Ecuador, Facultad de Ciencias Económicas, Quito-Ecuador*, Pp. 98. http://www.dspace.uce.edu.ec/handle/25000/9919

Velez, V. M. (2016). Elaboración de un plan de Exportaciones de flores tropicales haciael mercado de Estados Unidos-California. *Tesis de grado previo a la obtencióndel título de Ingeniería en Comercio Exterior, Universidad Laica Vicente Rocafuerte de Guayaquil, Facultad de Administración, Guayaquil-Ecuador*, Pp. 138. http://rraae.org.ec/Record/ULVR_bf2afb9100f0ca7d851457cad312f4cb

Villacres, E. G. (2011). Estudio de la Exportación de flores orgánicas en la variedad de Calla Lilies Procentes de serrania Ecuatoriana hacia los Estados Unidos de América en el periodo 2001-2010. *Tesis de grado previo a la obtención del título de Licenciada Multilingüe en Negocios e Intercambios Internacionales, Pontifica Universidad Católica del Ecuador, Facultad de Comunicación, Lingüística y Literatura, Quito-Ecuador*, Pp. 110. http://repositorio.puce.edu.ec/handle/22000/3878

Watanabe, K., Kobayashi, A., & Endo, M. y. (2017). CRISPR/Cas9-mediated mutagénesis of the dihydrofavonol-4-reductase-B (DFR-B) locus in the Japanese morning glory Ipomoea (Pharbitis) nil. *Scientific Reportds*, N° 10028; DOI:10.1038/s41598-017-10715-1.