

## Article

# Export of Organic Cape Gooseberry (*Physalis peruviana*) as An Alternative Illicit Crop Substitution: Survey of Consumers in Namur, Belgium

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**Abstract:** The social situation that indigenous people encounter in rural areas of Colombia is linked to social disparities and a dearth of opportunities for their products. Illicitly harvesting coca plants affords them resources they would not receive in the conventional market. This study investigates the feasibility of exporting organic gooseberries cultivated in conflict-affected regions of Colombia to European countries. Such exports could offer a means of crop substitution for indigenous communities that currently rely on coca farming for their sustenance. Additionally, this article features an exploratory analysis of consumer attitudes towards organic cape gooseberry in Namur, Belgium. This study employed surveys of 158 individuals in 2022 to gauge consumer perception and used the ordinary least squares method in the econometric modeling of foreign trade behavior. The modeling utilized 6233 observations between 2015 and 2022 about exports to European nations. Surprisingly, dehydrated gooseberry snacks were found to be the preferred method of consumption in Namur, Belgium, as opposed to fresh fruit. The export of Colombian cape gooseberries has secured a strong presence in Europe, with its price–quantity correlation demonstrating a high inelastic demand. This implies that price changes have minimal impact on the quantities purchased overseas. Organic cape gooseberries have significant potential for indigenous land. However, this study is exploratory and limited to the variables identified in the ICECOMEX databases in Colombia. Further research should consider the consumption of organic cape gooseberries in other European cities.

**Keywords:** consumer; exportation; cape gooseberry; crop substitution; rural economy



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## 1. Introduction

Colombia has experienced one of the longest-running armed conflicts globally. Primarily, its rural regions are subjected to violence, resulting in significant repercussions for the peasant, Afro-Colombian, and indigenous communities. The actions of various armed groups have led to the forced relocation of and the unlawful seizure of land from these communities. Colombia's climatic conditions, fertile land, and access to water sources facilitate the cultivation of cannabis and coca, making the country an ideal location for drug production and exportation via the infamous “cocaine routes.” Consequently, “it is essential to study it to create effective interventions within their populations through established processes such as crop substitution” [1].

The reduction in illicit crops holds significant environmental repercussions, as drug trafficking is known to cause damage, including “deforestation, soil loss, the decrease in water resources, the loss of biodiversity, and the loss of vital functions of ecosystems” [2]. Coca crops are often concealed in forests, and trees are often burned to make room for

coca cultivation, which often displaces traditional crops and is sometimes found within protected areas. Peasants have noted that the conflict and forced eradication of coca plants have driven many to cultivate the crop in different territories [3].

Cape gooseberry, belonging to the Solanaceae family, is a fruit native to the Andean region and is related explicitly to Peru, as evidenced by its scientific name, *Physalis Peruviana*. It thrives in elevations ranging from 1800 to 3600 meters above sea level, making Colombia an ideal location for its cultivation. According to Analdex [4], gooseberry exports were valued at USD 35,678,351 FOB. The properties of the cape gooseberry have drawn global attention. This versatile fruit can be used in salads and transformed into jams, fruits, yogurts, and ice creams. Additionally, it contains valuable components that have been found to have therapeutic and nutritional benefits.

It is imperative to display the varieties of crops available, including exotic fruits like gooseberry, to encourage indigenous individuals to remain in their territories and grow lawful crops. Exporting to European countries where it is used in haute cuisine dishes can lead to reasonable profitability. The indigenous people still determine the profitability of exporting the highly sought-after fruit to Europe. To identify potential alliances, a market study must be conducted in Namur, Belgium. Therefore, the critical inquiry is whether organic cape gooseberry, cultivated by the Colombian indigenous people amidst the armed conflict, can be exported to Europe.

For this purpose, we sought to answer questions such as: What would consumers in Namur, Belgium, think of organic gooseberries grown by indigenous Colombians? What is the export behavior of Colombian gooseberries to other parts of the world? There needs to be more research on cape gooseberry as a substitute for illicit crops or consumer perception surveys in Europe, as existing studies focus solely on its health benefits.

This article showcases cape gooseberry as a viable alternative crop for indigenous communities relying solely on coca cultivation. This study demonstrates the high demand for cape gooseberry in Namur, Belgium, where 57.6% of the respondents found it exotic and 52% appreciated its flavor. Additionally, the indigenous people prefer to consume cape gooseberry as a dehydrated snack. This discovery is significant because it allows the locals to concentrate on producing and selling the dried fruit, avoiding the risks associated with exporting fresh fruit that may spoil during transit. Moreover, by analyzing export behavior, this study highlights Europe's excellent opportunity to export cape gooseberry, proving an inelastic demand for this product. This situation arose because some countries have only recently negotiated with Colombia and consume cape gooseberry as a Giffen good.

In the current context of Colombian agriculture, replacing illegal crops has become a significant element in the post-conflict framework. This involves mobilizing efforts towards a profitable market that contributes to the substitution process and the growth of indigenous economies. The goal is to establish a profitable industry that adheres to legal regulations and supports sustainable development.

## 2. Literature Background

### 2.1. Cape Gooseberry

The nutritional description of cape gooseberry indicates that it includes vitamin C (46 mg/100 g), B complex vitamins, withanolides, flavonoids, polyphenols, carotenoids, and essential fatty acids [5]. Regarding its sugar content, the fruit holds a high level of fructose (29 g/100 g) and sucrose (35 g/100 g). The ethanol extract of *Physalis Peruviana* demonstrates anti-hepatic properties and inhibits the proliferation of hepatic cancer cells. Cape gooseberry is utilized for medicinal purposes to address ailments such as malaria, asthma, hepatitis, dermatitis, and rheumatism and is also recognized as a diuretic [6].

Organic fruit is cultivated entirely by natural means, without any artificial intervention. It is grown without using fertilizers, pesticides, or preservatives, relying solely on the natural conditions for its development, such as climate and soil type. The methods employed for producing, collecting, and selling organic fruits and vegetables are always sustainable and environmentally friendly. No pesticides, fertilizers, or chemicals are used

to ensure the optimal development of crops. The cultivation, harvesting, storage, and sale of these products are chemical-free.

Moreover, they do not contain genetically altered components. It has been demonstrated that organic fruits and vegetables can have a higher nutrient content [7]. Organic fruits are preferred in European countries, and indigenous Colombians rely on organic farming.

Gooseberry is also referred to as *alkequenje*, wild tomato, and cape gooseberry, and it is a fruit that boasts excellent nutritional and healing properties. One of its primary benefits is its antioxidant properties. Gooseberry is a natural source of potent antioxidants that slow the action of free radicals and prevent the premature deterioration of cellular tissue throughout the body. It also acts as a diuretic, helping to remove excess fluid from the body, and it is negatively satiating and calorie-dense. Thanks to its high fiber content, particularly pectin, cape gooseberry supports healthy digestion and is recommended for occasional constipation.

Additionally, its fiber provides satiating effects, making it suitable for weight loss or weight-control diets. It may also assist with weight loss efforts. Moreover, it has mild laxative properties and can aid in regulating intestinal transit while providing hydration to the body. Thanks to its diuretic and satiating properties, cape gooseberry is classified among the fruits that assist in weight loss. Furthermore, it is abundant in vitamins A, B, and C, fiber, potassium, phosphorus, iron, and zinc [8].

## 2.2. Organic Farming vs. Conventional Farming

Over recent years, organic farming has gained recognition in domestic and global markets for its environmental significance and potential for lower production costs. Using phytosanitary pruning in organic management allows for better ventilation, which reduces pests and diseases and eliminates the need for significant investments in agrochemical products, resulting in improved production costs [9].

According to Laurin et al., “producing citrus fruit and vegetables using organic farming represents a saving in the cost of energy, fertilizers, and phytosanitary products of more than 75%, compared to the conventional production system” [9].

Sustainability is another aspect considered in organic farming, for example, “improving working conditions for workers, strengthening social cohesion, and distributing resources more equitably” [10]. These farmers, peasants, and indigenous people utilize their traditional knowledge to cultivate crops. Organic agriculture enables the appreciation of this knowledge, prioritizing it over agrochemical products, thus reducing dependency on them while maintaining traditional values [10].

## 2.3. Benefits of Fruit Export in Poor Countries

In the 2030 Agenda for Sustainable Development, the main goal is to eliminate poverty in all forms. The United Nations reports that 735 million individuals lived on less than USD 1.90 per day in 2015 [11], highlighting the need for sustainable economic models that reduce poverty as a shared objective of this effort.

Due to the biodiversity and vast rural areas of developing nations, they are an attractive product in international organic agriculture markets [12]. The case in Colombia holds immense potential owing to the ideal land and climate for fruit and vegetable cultivation in Colombia. Concerning exports, Colombia caters to the markets in Europe, the USA, and China [13].

The success of the cape gooseberry chain is primarily attributed to the export activities and selection processes of the farmers who have successfully overcome challenging periods, comprehended the market, and adapted to it [14]. A research study conducted in rural Mexican regions found that organic farming positively influences the income of rural families living in poverty. Organic farming has become reliable for enhancing rural well-being [15].

#### 2.4. Alternative Crops

Cocoa shows promise as a viable alternative to illegal crops in Colombia. Farmers opt for ecological and profitable substitutes like cocoa instead. The National Comprehensive Program for the Substitution of Illicit Crops (PNIS) has rewarded 99,097 peasant families who willingly transitioned from unlawful activities to flourishing cocoa cultivation. In Colombia, cocoa has emerged as a promising alternative, as 25,000 hectares of illicit crops have been replaced by it [16].

Beekeeping has emerged as a productive alternative to illicit crop cultivation and illegal mining, with increasing popularity nationwide. The commitment of our farmers to beekeeping is notable, and they perceive it as an opportunity to improve their lives and generate better income and conditions, all within the bounds of legality. That commitment is currently reflected in the growth indicators presented by this sector, as noted by Minister Zuluaga [17].

Coffee is in constant worldwide demand and can provide farmers with a reliable source of income. Colombia's exceptional coffee is well known and can be a sustainable alternative to growing coca crops.

Palm oil has become a popular crop in Colombia despite its environmental controversy. However, sustainable farming practices are being promoted to address these concerns.

Sugarcane is a traditional crop in Colombia and could be an alternative for farmers currently growing coca [18].

In Guaviare, the cultivation of chontaduro has become a valuable industry, sustaining over 650 families in the region [19].

To support the closure of the agricultural frontier, promote agriculture with low greenhouse gas (GHG) emissions, and generate peace in territories affected by violence, the Sustainable Colombia Fund (FCS) is committed to producing chains of products such as açai and chontaduro while also investing in ecological restoration. In addition, the FCS aims to provide opportunities for local communities to generate income by utilizing the fruits of these chains [20].

#### 2.5. Importance of the Exotic Cape Gooseberry Fruit in Colombia and Europe

The cultivation of cape gooseberry is of great importance in Colombia for several reasons:

**Economic impact:** the cape gooseberry has a growing economic impact on Colombia, as the country is the biggest producer and exporter of this fruit globally.

**Employment generation:** Cape gooseberry cultivation is crucial for generating employment in Colombia. Labor accounts for 45% of the production costs, including harvest and post-harvest, with women heading households assuming a significant portion of this labor.

**Rural development and family economy strengthening:** the cultivation of cape gooseberries generates rural development and strengthens the family economy [21].

**Food safety:** gooseberry is crucial for ensuring food security and meeting high demand in international markets.

**Nutritional benefits:** gooseberry is a healthy and nutritious fruit with multiple uses in gastronomy [22].

Gooseberry holds significant importance in Europe for various reasons:

**Consumption:** Cape gooseberry is commonly used in Europe to garnish dishes, cocktails, and salads, as a snack, and to accompany beverages. Additionally, it is highly valued for its unique flavor and potential health benefits.

**Imports:** The Netherlands is the European market that purchases the highest volume of Colombian cape gooseberries. Between January and April 2019, there was an 11.2% increase in international fruit sales. In the first four months of the year, the Netherlands was the destination for 69% of the products sold, which amounted to USD 10.3 million.

**Other markets:** The fruit's external sales from Colombia amount to USD 1.52 million, with the United Kingdom accounting for 10.2%. Belgium is also considered a significant market for Colombian cape gooseberry.



Therefore, cape gooseberry plays a vital role in the Colombian economy and the European market [23]. The importing of exotic fruits into Europe has experienced an upward trend. In 2017, European buyers imported 40,000 metric tons of exotic tropical fruit exclusively from developing countries. The value of these imports reached €122 million in 2017, marking a growth since 2012. The primary import markets comprise the Netherlands, France, and Belgium, representing 86% of these purchases. Within this subset, the Netherlands has emerged as a recognized re-exporter of unusual fruit, with Germany and France serving as the chief destinations.

Exotic fruits are niche products in European countries due to their limited production within Europe. Nevertheless, lychee, passion fruit, dragon fruit, star fruit, and gooseberry are becoming popular among European consumers. Additionally, the organic market is gaining interest within this exotic fruit niche, which presents the possibility of significant profits. Specialized importers already exist in this field. In sum, the rising consumer demand for exotic fruits is fueling the growth of their import into Europe [24].

### 3. Theoretical Framework

#### 3.1. Econometric Models

The most frequently utilized econometric models can vary based on the field of study and available data. Presented below are several of the most widespread econometric models:

1. Simple linear regression model: This model is one of the most basic and commonly used. It involves two variables, one of which is dependent on the other.
2. Multiple linear regression model: this model is employed when there is more than one independent variable.
3. Logistic regression model: this model is employed when the dependent variable is binary.
4. Time series model: this model analyzes data collected over time.
5. Simultaneous equation model: this model is employed when the dependent and independent variables are simultaneously determined.
6. Panel data model: this model is employed when data available varies over time and among individuals.
7. ARIMA models (integrated autoregressive moving average models): these statistical models employ variations and regressions of data to identify patterns for future predictions.
8. VAR models (autoregressive vector models): these econometric models capture the interdependent linear relationships between multiple time series.

These are just a few examples. Many other econometric models are employed in various fields and contexts [25]. The ordinary least squares (OLS) method is an estimation technique widely used in economics and econometrics due to its various advantages. Here are some of them:

- a. Conversion of data into a specific model: the OLS method allows us to convert raw data into a specific model that can be analyzed.
- b. Empirically supported decision-making: the OLS models generate estimates grounded on empirical data, bolstering decision-making.
- c. Obtaining results from sparse data: the OLS method can handle sparse data and still provide meaningful results.
- d. Information retrieval from the information basket: the OLS models can help retrieve valuable information from a large and complex data set.
- e. Empirical contrasts with economic reality: the OLS models allow empirical contrasts with economic reality, which helps to validate or refute economic theories [26].

Furthermore, the OLS econometric models enable us to comprehend and analyze the economy's operation using theoretical constructs. These models are particularly beneficial for quantitatively assessing the public policies suggested by economic agents.

### 3.2. Consumer Behavior

According to Solomon [27], consumer behavior encompasses the various processes individuals or groups undergo when selecting, purchasing, and utilizing goods and services to satisfy their wants and needs. It encompasses the actions, processes, and social relationships that individuals, groups, and organizations sustain for obtaining, using, and consistently experiencing products, services, and other resources.

Various factors, such as values, demographics, and purchasing power, impact consumer behavior. Cultural, social, personal, and psychological factors are the four leading influencers that affect consumer behavior. Perception involves a three-stage process: initially, an individual is exposed to various environmental stimuli, followed by selective attention to the relevant information, and, ultimately, comprehension of that information. It is crucial to note that all three phases are essential and interconnected [28].

## 4. Data and Methods

In order to achieve the objectives, we developed an exploratory methodology for a consumer perception case study and econometric modeling of export behavior, as detailed below.

### 4.1. Methodology for Consumer Perception in Namur, Belgium

The survey was conducted in Namur, Belgium, in 2022, with 158 participants. The research aimed to ascertain consumer perceptions of cape gooseberry, with a preliminary pilot test identifying the proportion of individuals familiar with and having consumed the fruit. Based on these data and utilizing the formula for sample size calculation for proportions with a maximum allowed error of 5%, the resulting sample size was calculated as follows:

$$n = \frac{Z^2_{\alpha/2} * p * q}{d^2} \quad (1)$$

where:

p is the proportion found in the sample; it was found that p = 12%.

q is (1 – p), equivalent to 88%.

d<sup>2</sup> is the precision desired for the study, which was defined at 5%.

For the 95% confidence defined in this study:

$$Z^2_{\alpha/2} = 1.96^2 = 3.8416$$

When applying the formula, the sample size was determined:

$$n = 158$$

An exploratory analysis was conducted to evaluate the behavior and distribution of variables, identify any outliers, and determine any data collection failures or typographical errors. Normality tests were performed on the relevant variables to evaluate their distribution behavior. Then, we estimated the bivariate associations between the variables analyzed in the utilized tool and the characterization variables of the population consulted. After identifying the variables of interest, we conducted a simple and multiple correspondence analysis to visually illustrate the most robust associations and relationships discovered in this study.

A significance level of  $p < 0.05$  was utilized to validate the normality hypotheses. The quantitative variables were presented with their corresponding central tendency and dispersion measures based on their regular or non-normal distribution, while categorical variables were indicated as proportions. The statistical analysis was conducted using the SPSS V25 software package.

#### 4.2. Methodology for Econometric Modeling

To perform the econometric modeling using the data from Icecomex, we estimated the following mathematical equation through OLS (ordinary least squares) estimation:

$$\text{LnQuantity}_i = \beta^0 + \beta^1 \text{LnPrice}_i + \beta^2 \text{VFOB}_i + \beta^3 \text{Vfreight}_i + \beta^4 \text{Vinsurance}_i + U^i$$

where:

*LnQuantity<sub>i</sub>*: quantities of cape gooseberry exported by Colombia for each year *i*.

*LnPrice<sub>i</sub>*: unit price per net kilo of cape gooseberry for each year *i*.

*VFOB<sub>i</sub>*: FOB value for each year *i*.

*Vfreight<sub>i</sub>*: freight value for each year *i*.

*Vinsurance<sub>i</sub>*: insurance value for each year *i*.

*U<sup>i</sup>*: all additional variables that affect the calculation of exported quantities but were not previously included in the model estimation.

The statistical software with econometric applications R i386 version 3.4.4 was utilized to systematize the data and present tables, graphs, and statistics.

## 5. Results

### 5.1. Results of Consumer Perception

In the exploratory case study, some data were gathered to consider the results in the consumer perception of consuming organic gooseberries in Namur, Belgium, in 2022. Table 1 indicates the count of individuals in the sample who had consumed cape gooseberry. Table 2 shows the consumption preferences, that is, how people want to consume gooseberry. Table 3 shows the reasons why they would consume cape gooseberry, given some answers to select. Table 4 shows the places where they would like to go to buy gooseberry.

**Table 1.** Cape gooseberry consumption.

	Frequency	Percentage	Valid Percentage	Accumulated Percentage
Yes	158	89.8	89.8	89.8
No	18	10.2	10.2	100.0
Total	176	100.0	100.0	

**Table 2.** Organic cape gooseberry consumption preference.

	Frequency	Percentage	Valid Percentage	Accumulated Percentage
Fresh fruit	28	17.7	17.7	17.7
Jam	31	19.6	19.6	37.3
Sauce for meat and salads	4	2.5	2.5	39.9
Dehydrated snack	95	60.1	60.1	100.0
Total	158	100.0	100.0	

### 5.2. Results of Exploratory Econometric Modeling

The following demonstrates the exploratory econometric model of the product export behavior data.

In 2015, 3091 exports were made to 24 countries, with 2472 being sent to Europe, 539 to America, and 80 to Asia. To clarify, Europe accounted for approximately 80% of the total exports across all three continents. The most significant number of shipments were sent to the Netherlands. Specifically, 1702 shipments accounted for 69% of the total exports to Europe and 55% of all shipments across the three continents, as indicated in Table 5.

From 2015 to 2022, an average of 3142 observations of cape gooseberry exports to the three continents were made yearly. By 2019, the commercial relationships with all

countries where negotiations took place in 2015 were reportedly maintained, except for Sweden. Furthermore, a commercial relationship with Greece began in 2017 and persisted until 2019. Europe's proportion of Colombia's overall exports remained near 80%, peaking at 83% in 2015 and reaching its minimum in 2018 and 2019 at 76%. In comparison, the Netherlands showed higher imports than other countries annually. The export weight reached the maximum value in 2019 with an average of 3016 net kilos. However, Germany displayed relatively larger imports by weight until 2021.

**Table 3.** Reasons to consume cape gooseberry from Colombia versus gender.

	Total	Gender		
		Men	Women	Other
Because it is an exotic fruit	91	40	51	0
	57.6%	60.6%	58.0%	0.0%
Because of its flavor	83	35	45	3
	52.5%	53.0%	51.1%	75.0%
Because of its nutrients	70	24	43	3
	44.3%	36.4%	48.9%	75.0%
To support peasants from conflict zones in other countries	35	21	13	1
	22.2%	31.8%	14.8%	25.0%
To protect the environment	22	12	10	0
	13.9%	18.2%	11.4%	0.0%
Not applicable	3	1	1	1
	1.9%	1.5%	1.1%	25.0%
BASE	158	66	88	4
	192.4%	201.5%	185.2%	200.0%

**Table 4.** Places of consumption of the cape gooseberry versus gender.

	Total	Gender		
		Men	Women	Other
Supermarkets	149	65	82	2
	94.3%	98.5%	93.2%	50.0%
Specialized markets for organic products	86	36	48	2
	54.4%	54.5%	54.5%	50.0%
Restaurants	39	16	20	3
	24.7%	24.2%	22.7%	75.0%
Vending machines	18	8	9	1
	11.4%	12.1%	10.2%	25.0%
Internet	12	7	4	1
	7.6%	10.6%	4.5%	25.0%
BASE	158	66	88	4
	192.4%	200.0%	185.2%	225.0%



**Table 5.** Distribution of shipments by continent in 2015–2022.

Year	Destination Continent	Freq.	Percent	Cum.
2015	America	539	17.44	17.44
	Asia	80	2.59	20.03
	Europe	2472	79.97	100.00
	Total	3091	100.00	
2016	America	563	18.14	18.14
	Asia	88	2.84	20.98
	Europe	2451	78.99	99.97
	Total	3103	100.00	
2017	America	474	15.35	15.35
	Asia	83	2.69	18.04
	Europe	2530	81.96	100.00
	Total	3087	100.00	
2018	America	425	14.37	14.37
	Asia	73	2.47	16.84
	Europe	2460	83.16	100.00
	Total	2958	100.00	
2019	America	537	17.44	17.44
	Asia	73	2.37	19.81
	Europe	2469	80.19	100.00
	Total	3079	100.00	
2020	America	562	17.34	17.34
	Asia	84	2.59	19.93
	Europe	2595	80.07	100.00
	Total	3241	100.00	
2021	America	648	20.08	20.08
	Asia	127	3.94	24.02
	Europe	2452	75.98	100.00
	Total	3227	100.00	
2022	America	668	20.24	20.24
	Asia	130	3.94	24.18
	Europe	2502	75.82	100.00
	Total	3300	100.00	

On average, 3135 observations were taken each year for the modeling process. The dependent variable chosen for the analysis was the quantity of cape gooseberry exports carried out in logarithmic form (to smooth the data) to 27 countries across three continents (Europe, Asia, and America) from 2015–2022. The USD price of each net kilogram of cape gooseberries (also in logarithmic form) was utilized as an independent variable for the demand analysis. To prevent specification errors caused by omitting relevant variables, we included the FOB value from the negotiation, insurance value, and freight value as additional variables. Furthermore, these costs are the importer’s considerations when purchasing and may strongly correlate with the dependent variable, as indicated in Table 6.

**Table 6.** OLS estimate for cape gooseberry exports in Colombia in 2015–2022.

	2015	2016	2017	2018	2019	2020	2021	2022
Variables	Lnquantities	Lnquantities	Lnquantities	Lnquantities	Lnquantities	Lnquantities	Lnquantities	Lnquantities
LnPrice in USD	−0.0569 (0.0633)	0.330 *** (0.0558)	−0.154 ** (0.0660)	−0.666 *** (0.0621)	0.168 *** (0.0498)	0.0106 (0.0521)	−0.232 *** (0.0488)	−0.465 *** (0.0581)
Value FOBCOP	$6.24 \times 10^{-8}$ *** ( $1.18 \times 10^{-9}$ )	$5.42 \times 10^{-8}$ *** ( $1.06 \times 10^{-9}$ )	$3.20 \times 10^{-8}$ *** ( $7.62 \times 10^{-10}$ )	$2.74 \times 10^{-8}$ *** ( $6.42 \times 10^{-10}$ )	$2.00 \times 10^{-8}$ *** ( $5.04 \times 10^{-10}$ )	$2.44 \times 10^{-8}$ *** ( $5.55 \times 10^{-10}$ )	$2.71 \times 10^{-8}$ *** ( $5.41 \times 10^{-10}$ )	$2.64 \times 10^{-8}$ *** ( $4.74 \times 10^{-10}$ )
Insurance Value	0.00999 *** (0.00147)	0.0129 *** (0.00175)	0.00386 *** (0.000608)	0.00435 *** (0.000841)	0.0139 *** (0.00208)	0.00799 *** (0.00116)	0.00436 *** (0.000951)	0.00284 *** (0.00102)
Freight Value	$-2.38 \times 10^{-5}$ ( $1.88 \times 10^{-5}$ )	$1.79 \times 10^{-5}$ ( $1.35 \times 10^{-5}$ )	$5.51 \times 10^{-5}$ *** ( $1.32 \times 10^{-5}$ )	$6.02 \times 10^{-5}$ *** ( $1.18 \times 10^{-5}$ )	$3.07 \times 10^{-5}$ *** ( $7.49 \times 10^{-6}$ )	$7.01 \times 10^{-5}$ *** ( $1.06 \times 10^{-5}$ )	$4.90 \times 10^{-5}$ *** ( $1.02 \times 10^{-5}$ )	$4.23 \times 10^{-5}$ *** ( $8.25 \times 10^{-6}$ )
Constant	5.535 *** (0.0943)	4.880 *** (0.0929)	6.044 *** (0.111)	6.920 *** (0.0970)	5.640 *** (0.0795)	5.785 *** (0.0803)	6.073 *** (0.0780)	6.428 *** (0.0923)
Observations	3087	3101	3087	2958	3079	3241	3227	3300
R-squared	0.499	0.500	0.387	0.423	0.371	0.429	0.466	0.515

Standard errors are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

According to demand analysis, it is anticipated that an increase in the USD cost per kilogram of cape gooseberries will lead to a decrease in imports. This was demonstrated in 2017, 2021, and 2022. For instance, in the previous year, the imported quantities decreased by an average of 0.465%, with a 1% rise in the USD cost of a kilogram of cape gooseberries being observed while holding the other variables constant at a significance level of 99%. In 2016 and 2019, the coefficients demonstrated a positive correlation between the price in USD and the amounts with a significance level of 99%. This outcome can be attributed to some countries' recent exclusive negotiations with Colombia, where cape gooseberry is consumed as a Giffen good. To specify, in 2016, only Romania, Sweden, Vietnam, and Switzerland conducted business with Colombia. Meanwhile, in 2022, Kuwait, the Czech Republic, Jordan, and Bahrain were the only countries involved in negotiations.

Upon reviewing the relationship between the quantities of cape gooseberry demanded and each variable, we discovered a positive correlation in each case for the FOB (free on board) value and insurance value, with statistically significant coefficients for all years being at a 99% confidence level. This correlation suggests that a 1% increase in the FOB value in 2022 corresponds to an average demand increase of 0.00000264%, with the other variables remaining constant. Furthermore, a 1% increase in the insurance value was positively correlated with an average increase of 0.284% in the quantities demanded while keeping the other variables constant. The coefficient signs for the freight value were also positive, but for 2015 and 2016, they were not significant. These findings are consistent with a positive correlation between the quantities and the incurred costs for the importer.

Upon examining the R<sup>2</sup> or determination coefficient, findings indicate that the model demonstrated an average goodness of fit of 44.9%, indicating that the exports can be explained by around 45% of the chosen independent variables. The optimal adjustment was observed in 2022, at 51.5%, whereas the lowest was noted in 2019, amounting to 37.1%. Lastly, the residual analysis portrayed a zero mean and consistent variance, signifying residuals with a normal distribution, as illustrated in Table 7.

**Table 7.** The residual trend in the OLS estimation.

Estimation Residuals	Obs	Mean	Std. Dev.	Min	Max
2015	3087	$1.82 \times 10^{-10}$	1.360124	−8.623446	2.596879
2016	3101	$-1.22 \times 10^{-10}$	1.255341	−8.482386	3.542569
2017	3087	$3.73 \times 10^{-10}$	1.366342	−19.50532	3.02686
2018	2958	$5.45 \times 10^{-10}$	1.259059	−12.86184	1.398785
2019	3079	$-6.56 \times 10^{-10}$	1.242588	−12.52607	2.268221
2020	3241	$-7.53 \times 10^{-10}$	1.295451	−10.14043	2.809656
2021	3227	$-1.03 \times 10^{-9}$	1.34143	−14.57074	2.524247
2022	3300	$1.64 \times 10^{-10}$	1.244252	−13.04535	1.674638

## 6. Discussion

Considering the geography of drugs, as asserted by Gómez et al. [1], enables us to observe the social structures created by illegal cultivation. Through this, we gain insight into the individual and indigenous families, their productive organization, and the potential for transformation [29]. There is a need to introduce new social standards and conditions to improve the lives of these communities. Then, to achieve successful social marketing [30], it is necessary to implement improvements and modifications to enhance the quality of life. It is essential to acknowledge the geography of the issue, keeping in mind that economic dynamics within society are determined by the actions of individuals and their environment [1]. Various approaches exist, including replacing illicit crops with legal crops like cape gooseberry.

Success stories, like those of chontaduro and acai fruits in the Guaviare region of Colombia, which are exotic fruits with excellent nutritional properties, have enabled communities to survive by relying on these crops rather than resorting to coca cultivation. Additionally, the production of highly sought-after honey in national and international markets has succeeded. This is according to a study published in the newspaper *El Espectador* in 2022 [20]. This model can be implemented in regions inhabited by indigenous people to demonstrate the feasibility of enhancing their families' economy without relying on coca by introducing a product with global marketability that can be sold at higher prices than local sales prices. The climate is temperate in the region where these indigenous reserves are located, making cape gooseberry an ideal crop choice. The indigenous people have attempted coffee production, but it has proven unprofitable due to the high production costs and having only one annual harvest.

Cape gooseberry has multiple harvests annually within its vegetative cycle, but the exact quantity may differ based on the specific cultivation and irrigation conditions. Colombia has a sugarcane monopoly, where only affluent families can cultivate sugarcane. According to the Ministry of Agriculture and Rural Development [21], women who grow gooseberries and are heads of household generate 45% of the production costs for this fruit. This contributes significantly to rural areas in Colombia. Cape gooseberry has excellent economic potential, as expressed by Arias et al. [31], due to its exportation to countries like Germany, Belgium, and the Netherlands, where its unique characteristics, flavor, and properties are highly sought. The listed countries achieve a wholesale price ranging from 4.80 to 6.39 USD/kg, which exceeds the amount paid in Colombia (0.84 USD/kg) [31].

European consumers can assist Colombian markets with their preference for organic and exotic products and environmental sustainability. They prioritize health and the environment, making them valuable contributors to the Colombian market. Additionally, European markets exhibit a higher level of environmental consciousness. The nutritional benefits of cape gooseberry make it a desirable option for advertising purposes. Its high antioxidant properties and ability to prevent liver cell damage, as noted by Wang, Lin-Shiau, and Li [32], should be emphasized in advertising labels to highlight its nutritional value.

As evident, fruits like cape gooseberry offer positive externalities in terms of exports for the development of crop substitution. It should be noted that it already has a place and established objective buyers in the international market, which is crucial for successful exports and a network of allies.

According to Agraria.pe [24], fruit imports in Europe have grown; for example, this can be seen in the 40,000 tons imported in 2017 and how these fruits are imported from developing countries. The primary markets for imports are the Netherlands, France, and Belgium, which collectively represented 86% of these purchases. The challenge is the process of internal substitution within the territory, necessitating that growers—as a target audience—be persuaded to modify voluntary behaviors in the area to affect the social system with social marketing assistance. It is essential to consider that social marketing interventions must adhere to the ethical frameworks outlined by Kennedy and Santos [33] and should not cause harm to communities or growers. Therefore, before implementing any interventions, it is necessary to influence behavior change.

It is necessary to conduct market studies and establish reliable channels for producing, distributing, and developing their products. In this case, the technical and social viability of cultivating cape gooseberry presents itself as an option to the community. The solution must involve all parties, including coca producers, buyers, transporters, and distributors. Dependence on this activity can be avoided by implementing alternative development programs and assessing economic viability in each territory, as carried out by programs in Costa Rica. The community actively participates in these substitution projects and ensures compliance. Creating opportunities for improvement is crucial to guaranteeing equity and income redistribution. A dialogue with the involved actors will result in focused strategies.

Colombia's climate affords it a notable advantage in producing diverse fruit year-round. Because of this, according to Alvarez and Zuleta [13], it has an excellent opportunity for fruit exports. Conflict areas in Colombia can potentially augment families' rural earnings through the export of organic cape gooseberry agriculture. Martinez [15] sheds light on the favorable results in rural Mexico, serving as a prime example. Additionally, it is significant to mention that 60.1% of the respondents regarded the product as a snack. The product's presentation size and usefulness for the consumer can help to create a profile of potential organic consumers for supply.

Other noteworthy statistics indicate that 53% of men and 51.1% of women consume it based on its taste, while 36.4% of men and 48.9% of women consume it for its nutritional content. These figures are significant for contextualizing the product as a unique super-food brand. Belgium plays a crucial role in Colombia's cape gooseberry export market, according to the Ministry of Commerce, Industry, and Tourism [23]. By participating in these exports, the indigenous community can add value to their products through organic production. This fact positions cape gooseberry as a significant contributor to Colombian and European markets.

Exotic fruits have been well received in Europe due to their limited availability in European climates. These fruits are highly demanded when decorating dishes, cocktails, salads, and haute cuisine snacks [24]. For instance, during December's peak tourist season in Europe, restaurants experience a surge in demand for exotic South American fruits. It is widely acknowledged that organic agriculture has gained significant recognition from both farmers and consumers. It has become a thriving and profitable industry due to its numerous nutritional benefits, environmentally friendly nature, and significant economic and employment opportunities. The organic product market saw a 16% growth from the previous year, with Europe and the United States being the primary consumers.

Between 2015 and 2022, our study demonstrates that Europe accounted for nearly 80% of Colombia's overall exports, fluctuating between its peak of 83% in 2018 and its lowest point of 76% in the last two years. These findings illustrate Europe's increasing potential as a market for organic agriculture, with Belgium emerging as one of the more attractive consumers in 2022, importing an average of 3346 net kilos of cape gooseberry. This trend in the data, as confirmed by research utilizing an OLS model, indicates that the export of cape

gooseberry has gained a noteworthy foothold in Europe. Furthermore, the relationship between price and quantity shows a high degree of inelastic demand. Overall, the outlook remains favorable for the crop of this product in the European market. Despite its status as a commonly consumed good, purchasing cape gooseberry is largely insensitive to price fluctuations. It is worth noting that this study did not include consumption projections for Europe or, specifically, Belgium. Nevertheless, it significantly contributes to the academic community by offering an updated perspective on European consumer behavior towards cape gooseberry.

## 7. Conclusions

Based on a survey conducted in Namur, Belgium, consumers favor cape gooseberry as a dehydrated snack. This presents an advantage for exporting it from Colombia, as fresh cape gooseberry is prone to damage or disease. Furthermore, this study indicates that cape gooseberry is an exotic fruit, making it a suitable ingredient in gourmet dishes served in restaurants. Cape gooseberry, an exotic fruit rich in vitamins known to heal various maladies, remains relatively unknown in other nations. Additionally, it is a popular ingredient in haute cuisine. Supermarkets are the preferred location for 94% of the consumers who purchase cape gooseberries. As a result, demonstrations highlighting the fruit's diverse applications—like functional juices, salads, and jams—will be held. Consumers frequently need to be made aware of the fruit's versatility. This snack can be sold in specialized stores that offer healthy products, forming alliances with partners in other countries.

With its acceptance by countries like Belgium, this exotic fruit offers opportunities for ventures such as exporting gooseberry sauce for salads, meats, and jams, leveraging its exceptional flavor and color. This illustrates how indigenous reservations can develop their untapped potential by forming cooperatives, where they can gain knowledge about export processes and foreign allies with the government's support. Cape gooseberry cultivators in Colombia possess considerable expertise in cultivating this fruit near the capital city of Bogotá. A transfer of this knowledge could benefit indigenous farms located in conflict zones where coca is grown [14].

According to this research, as a second objective, it was proposed to analyze the behavior of gooseberry exports to Europe; this shows how Belgium reached an import of 3346 kilos from Colombia and, according to the econometric models used in this study, discovered an inelastic demand with Europe for this fruit, thus showing for the second time the great opportunity that indigenous people have to explore different cities in Belgium and Europe to export gooseberry. This can be further substantiated by Agraria's study [24], which indicates that most gooseberry imports (86%) come from three countries: the Netherlands, France, and Belgium. Colombian cape gooseberry export has gained prominence in Europe, and its price–quantity relationship demonstrates a highly inelastic demand.

The above indicates that price changes negatively impact the quantities bought overseas. This situation presents a promising future for cape gooseberry crops, as price fluctuations do not highly influence their purchase. This demonstrates an increasing demand for this product abroad, which supports organic exports with a focus on social causes. In the meantime, since 2016, Belgium has been a prominent buyer of cape gooseberries from Colombia. European countries are growing more interested in organic, healthful, and highly nutritious products.

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