

# SCIENTIFIC HORIZONS

Journal homepage: <https://sciencehorizon.com.ua>  
*Scientific Horizons*, 27(9), 121-133



UDC 338.43:339.564(85)

Doi: 10.48077/scihor9.2024.121

## Competitiveness of the La Libertad region in agricultural exports, Peru, 2011-2023

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### Article's History:

Received: 18.03.2024

Revised: 30.07.2024

Accepted: 28.08.2024

**Abstract.** The increasing global demand for high-value agricultural products emphasises the need to understand regional export competitiveness. The study aimed to evaluate La Libertad's comparative advantages in agricultural exports from 2011 to 2023. By employing the Revealed Comparative Advantage (RCA), Export Comparative Advantage (ECA), and Import Comparative Advantage (ICA) indices, alongside Porter's Diamond,

### Suggested Citation:

Soriano-Colchado, A.-M., Diez-Matallana, R.-A., Gómez-Oscorima, R.-M., Jiménez, L.-A., & Vasquez-Quispe, C.-Z. (2024). Competitiveness of the La Libertad region in agricultural exports, Peru, 2011-2023. *Scientific Horizons*, 27(9), 121-133. doi: 10.48077/scihor9.2024.121.



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the region's performance and the determinants of competitiveness across 11 key export products were analysed. These products include fruits such as blueberries, avocados, and grapes, as well as vegetables such as asparagus and piquillo peppers. The analysis revealed strong ECAs for fruits and vegetables, with values ranging from 1.56 to 7.08, and a promising specialisation in cane sugar (RCA of 1.28). The findings indicate that most of these products possess strong to moderate comparative advantages in international markets, with products like blueberries and avocados leading in competitiveness. However, certain challenges remain, including the need for strategic business management and technological innovation to maintain and improve the sector's competitiveness. The study underscores the importance of continuous monitoring and adaptation to ensure the sustainability and growth of Peru's agro-export sector. These findings offer valuable insights for policymakers and regional planners seeking to enhance La Libertad's agricultural export potential

**Keywords:** Porter's Diamond; fruits and vegetables; revealed comparative advantages

## INTRODUCTION

The competitiveness of agricultural exports is a key factor in a country's economic development. The agro-export sector, particularly in regions with fertile land and favourable climates, is essential in generating economic income and creating employment opportunities. At the regional level, understanding competitive advantages is crucial for ensuring the long-term sustainability of the agricultural industry, as agricultural exports are often seen as a catalyst for economic progress, particularly in developing countries, where they can contribute to poverty reduction, food security, and sustainable development. This research is highly relevant as it sheds light on the competitiveness of the agro-export sector in the La Libertad region of Peru, a significant hub for non-traditional exports. Evaluating regional performance can provide policymakers with insights to enhance competitiveness, address market challenges, and drive economic growth. Several researchers have studied the dynamics of agricultural exports. M. Babacan (2018) noted that international trade not only fosters economic growth but also enhances innovation and productivity within the business sector. Moreover, it strengthens competitiveness, a key driver for long-term development. J. Salas-Canales (2020) analysed the growth of Peru's agricultural exports, identifying a substantial increase in non-traditional exports. The author highlighted that exports of products such as blueberries, grapes, and avocados grew exponentially, with irrigation projects and trade agreements being significant contributors to this growth. A deeper look into Peruvian agriculture is provided by D.A. Escalante *et al.* (2023), who assert that between 2000 and 2019, exports of blueberries, grapes, avocados, and asparagus soared due to increased investments in agricultural technologies and infrastructure. This boost in productivity allowed Peru to surpass countries like Chile, the United States, and Mexico in the export of key products such as blueberries and avocados. The impressive performance of the agro-export sector has placed Peru among the world's leading exporters of high-value crops. These achievements are further enhanced by Peru's ability to meet international quality standards, which has

allowed it to access competitive global markets and ensure the success of its agricultural exports.

Additionally, the determinants of competitiveness in agriculture have been widely explained through Porter's Diamond Model, which has been recognised as a critical framework. According to P.H. Tsai *et al.* (2023) and P. Grdeń and A. Jakubczyk (2023), this model examines the factors that contribute to a country's or region's ability to compete in agriculture, highlighting four key determinants: factor conditions (labour, capital, infrastructure, and natural resources), demand conditions (including consumer preferences for agricultural products and market size), related and supporting industries (such as agricultural suppliers, machinery, and logistics), and firm strategy, structure, and rivalry (encompassing farm management practices and competition among agricultural producers). Government policies, investments in rural infrastructure, and the adoption of technological innovations are identified as pivotal factors influencing the agricultural sector's competitiveness both regionally and globally. In the research of G. Harya *et al.* (2023), this model emphasised the notion of competitive advantage from dynamic capabilities and the expectation of improving industry performance at the regional level, demonstrating the importance of policy frameworks and technological innovations. Its findings underscore the role of effective government in influencing the factors that create an enabling environment for agricultural innovation and competitiveness.

Given the significant role that agriculture plays in Peru's economy and the rapidly evolving global market, it is imperative to assess the comparative advantages of the La Libertad region's agricultural exports. This research aimed to evaluate the international competitiveness of the agro-export sector in La Libertad, with a focus on fruits and vegetables. By calculating the Revealed Comparative Advantage (RCA), Export Comparative Advantage (ECA), and Import Comparative Advantage (ICA) indices, this study seeks to identify the region's strengths and key determinants of competitiveness using Porter's Diamond framework. Additionally, this analysis will offer valuable insights into how La

Libertad can continue to enhance its competitive position in global markets, ensuring the sustainability and growth of its agro-export sector.

## MATERIALS AND METHODS

**Calculation of the Revealed Comparative Advantage Index to measure the competitiveness of agricultural export goods.** To calculate the comparative advantage index for agro-exportable goods, a modified version of T. Vollrath's (1991) approach was used. This version improves upon the original Balassa formula by avoiding double counting between country pairs, reducing the asymmetry between export and import values through the application of the natural logarithm (ln), and including imports in the original formula (Laursen, 1998). It is expressed through equations (1 to 3):

$$RCA_{ia} = ECA_{ia} - ICA_{ia}, \quad (1)$$

$$ECA_{ia} = \ln (X_{ia}/X_{in})/(X_{ra}/X_{rn}), \quad (2)$$

$$ICA_{ia} = \ln (M_{ia}/M_{in})/(M_{ra}/M_{rn}), \quad (3)$$

where *RCA* stands for Revealed Comparative Advantage, *ECA* represents Export Comparative Advantage, and *ICA* denotes Import Comparative Advantage. In these formulas, *X* and *M* refer to exports and imports, respectively. The subscript *i* refers to the country or region being analysed, *a* corresponds to the specific product under study, *r* indicates a group of countries or the rest of the world, and *n* represents the total goods, excluding product *a*. To evaluate the comparative advantages of the selected products within the fruit and vegetables category, equation (2) for *ECA* was used, focusing solely on export values, as Peru does not import these products. Conversely, for the analysis of sugar, which is both exported and imported, equation (1) for *RCA* was applied.

### Interpretation of possible ECA and RCA index values.

The interpretation of the value resulting from equation (2): a value greater than 1 indicates a comparative advantage, suggesting specialisation, while a value less than 1 indicates a comparative disadvantage, suggesting importation. Regarding the result of equation (1), the *RCA* can be positive or negative, depending on the *ECA* and *ICA* indices. If the value is positive, it indicates that the country has a comparative advantage in the given product, a strong export sector, and greater competitiveness; that is, the higher the value of the index, the greater the competitiveness and, consequently, the participation of that product in international trade (Vollrath, 1991). If the *RCA* index is less than 1, it indicates a comparative disadvantage in the product, with the country having a weak export sector and low competitiveness, making importation more favourable. A positive *RCA* indicates that the country or region has good competitive performance in the foreign market; if negative, it implies a comparative disadvantage in exports

(the product should not be exported). If the *ICA* is positive, imports have a comparative advantage (it is advantageous to import), whereas if negative, it shows that imports cannot compete in the domestic market due to low demand or the existence of factors (such as trade barriers) that limit or prevent their internal marketing. A combination of these indices may be found in the results: *ECA* > 0 and *ICA* < 0 with *RCA* > 0; *ECA* > 0 and *ICA* > 0 with *RCA* ≥ 0; *ECA* < 0 and *ICA* < 0 with *RCA* < 0 and finally *ECA* < 0 and *ICA* > 0 with *RCA* < 0 (the last two scenarios are undesirable for the country under consideration).

**Interpretation of possible ECA values.** M.E. Pérez-Romero *et al.* (2022), based on J. Hinloopen and C. Marrevijk (2004), classified the *ECA* values by ranges and interpreted them as follows: 0 ≤ *ECA* < 1: no comparative advantages. 1 < *ECA* ≤ 2: weak comparative advantage. 2 < *ECA* ≤ 4: moderate comparative advantage. *ECA* > 4: strong comparative advantage. To measure the competitiveness of the region's agro-export sector using revealed comparative advantage indices, the following information was considered: export and import values of selected agricultural products from the total merchandise of La Libertad and the rest of the world, in nominal US\$ FOB, sourced from the Central Reserve Bank of Peru (CRBP) (2022) and TradeMap (n.d.).

**Products under evaluation in the study and assessment sequence.** A sample of 11 export products from the region was selected, comprising vegetables (asparagus, artichokes, piquillo peppers, and paprika peppers), fruits (blueberries, avocados, grapes, mangoes, watermelons, and mandarins), and sugar cane derivatives (sugar for domestic consumption or industrial use). The *ECA* index was calculated separately for fruit and vegetables, as these products are only exported. The *RCA* index was then applied to sugar, followed by the respective index for each category that groups the products (fruit and vegetables). The analysis period spanned 12 years, from 2011 to 2023. To determine the export comparative advantage indices for each product for the period 2011-2023, the averages of the annual *ECA* values were used. The Import Comparative Advantage index for sugar was estimated using FOB import values over the same period. Measures of competitiveness based on trade flows assume the existence of free trade and do not account for distortions caused by trade barriers, exchange rate policies, tariffs, subsidies, or variations in demand due to changing consumption patterns. While the comparative advantage indices provide static results, competitiveness evolves over time, meaning it is dynamic.

## RESULTS AND DISCUSSION

**ECA index for fresh fruit.** The *ECA* indices for the products during the period 2011-2023 show values classified, according to M. Pérez-Romero *et al.* (2022), within the ranges of weak comparative advantage (watermelon: 1.29), moderate comparative advantage (mandarin:

2.57, grape: 2.79, and mango: 3.54), and strong comparative advantage (avocado: 5.40 and blueberry: 6.18). These values reflect their competitive performance in exports and specialisation, which is advantageous due to their significant presence in the external market, except in one case (watermelon), which shows a weak comparative advantage and limited participation in the external market. However, its specialisation would still be justified by a value greater than 1. The results of

the competitiveness measurements using the ECA indices are presented in Table 1. Blueberries, mandarins, grapes, avocados, and mangoes displayed an upward trend in competitiveness over the period. In the case of mandarins, the trend was downward until 2016, when it reached its lowest point, after which it increased steadily. Watermelon, however, showed a decline in its export competitiveness index and a reduction in its market share, with only one buyer: Chile.

**Table 1. ECA of fresh fruits**

Fruits	ECA
Blueberry	6.18
Avocado	5.40
Mango	3.54
Grape	2.79
Mandarin	2.57
Watermelon	1.29

**Source:** compiled by the authors based on Trade Map (n.d.)

The high competitive performance demonstrated by the ECA indices for blueberries and avocados, particularly the Hass and Fuerte varieties, reflects the dynamic and sustained growth of exports. This growth is attributed to their high profitability and increasing interest in the foreign market due to their nutraceutical properties, which are beneficial to human health, positioning them in important markets such as the United States and the Netherlands. Recently, exports have also been made to China, Belgium, Singapore, and Russia (Trade Map, n.d.). The growing global demand for blueberries and avocados, particularly from the US and Europe, has led national growers to dedicate more land to these crops, improve yields, and develop new varieties to meet consumer demand. According to the Fresh Fruit Report (2021), commercial intelligence analyses suggest there are large potential markets for these products, such as China and Japan. The area planted with grapes is relatively small, and the increase in acreage is moderate; however, yields in the region are very close to those of the main grape producers in the country (Ica and Piura). There is considerable potential for increasing grape production and productivity, as the region possesses the right soil and climate conditions for the successful development of the crop.

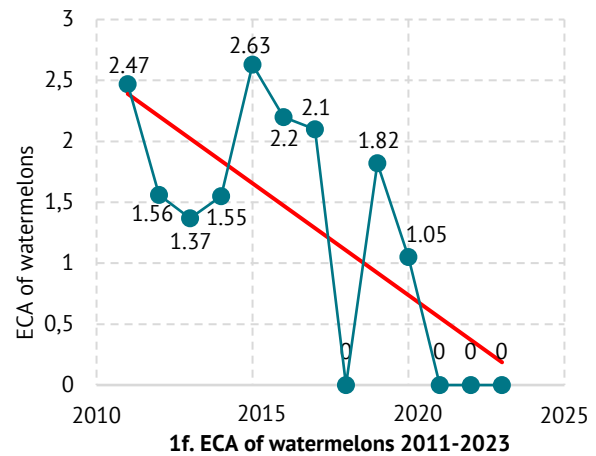
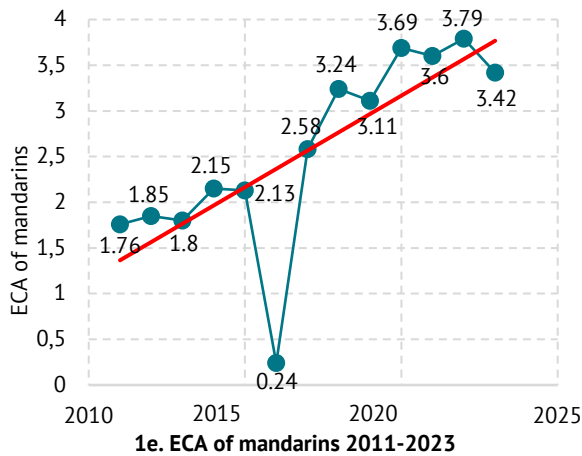
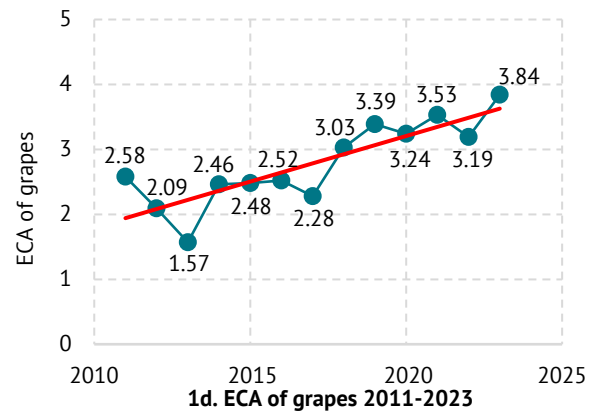
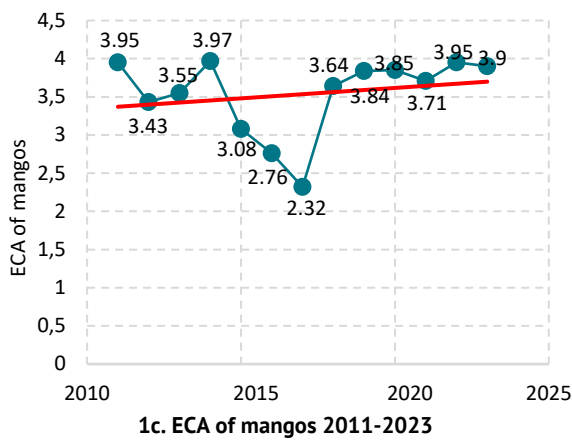
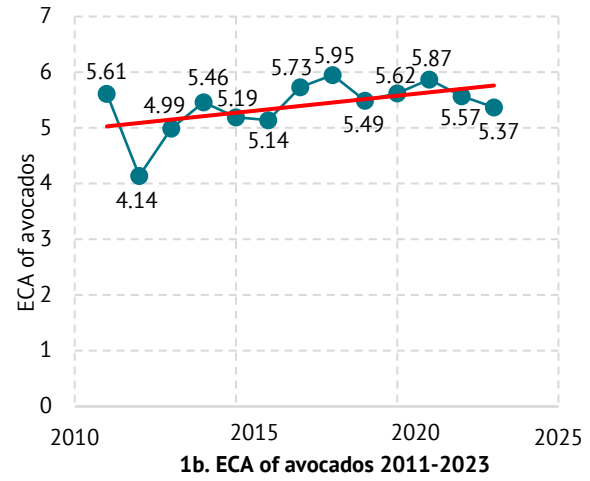
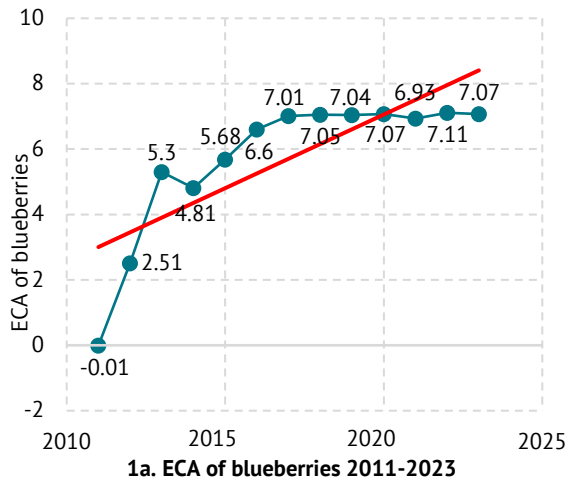
The provinces of Gran Chimú and Chepén concentrate most of the region's grape production, followed by Virú and Ascope. In terms of mandarins, the region's exports have gained momentum since 2016 (Fig. 1). The ECA index for this product increased significantly during the period 2016-2020, reaching +0.41 (Table 1), due to the rise in citrus exports, meeting the growing demand from the United States, the main importer, as well as from the United Kingdom, the Netherlands, Canada, and China. It is important to note that, according to V. Ballena (2019), the La Libertad region has increased citrus production and exports; however, its share of the national mandarin market remains low. This may be attributed to the climatic conditions of the northern Peruvian coast, characterised by high temperatures and humidity (Cáceres Candia *et al.*, 2021). Consequently, citrus fruits are susceptible to pests and diseases throughout their growth cycle, which adversely affects their productivity. Globally, Cyprus leads in yields per hectare with 50 tonnes, and China is the largest exporter.

Regarding vegetables (Table 2), asparagus (7.11), paprika peppers (5.71), and piquillo peppers (4.05) stand out, as they present ECA values greater than 4, indicating a strong comparative advantage. Artichokes (1.80) exhibit a weak comparative advantage.

**Table 2. ECA of fresh vegetables**

Vegetables	ECA
Asparagus	7.11
Paprika peppers	5.71
Piquillo peppers	4.05
Artichoke	1.80

**Source:** compiled by the authors based on Trade Map (n.d.)



**Figure 1.** ECA indices of fruits

**Source:** compiled by the authors

For asparagus, a key product for the region and the country, competitiveness increased throughout the period 2011-2023. It is worth noting that if the evolution of asparagus competitiveness is divided into two periods, there was a decline from 2013 to 2017, which coincides

with the boom in blueberry production and exports (2013-2014), which partially displaced asparagus cultivation. However, since 2018, Peru – and La Libertad in particular – has repositioned itself in the global asparagus market, resulting in increasing competitiveness indices (Fig. 2).

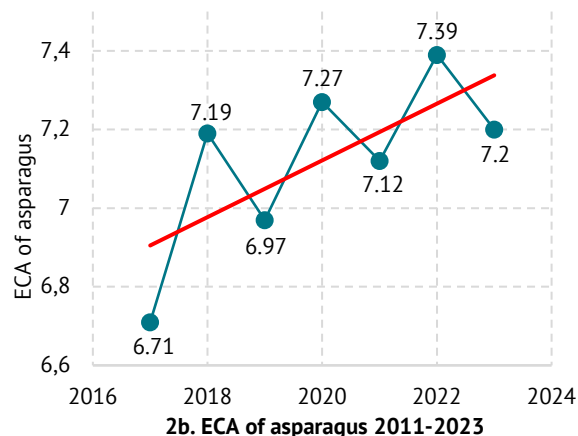
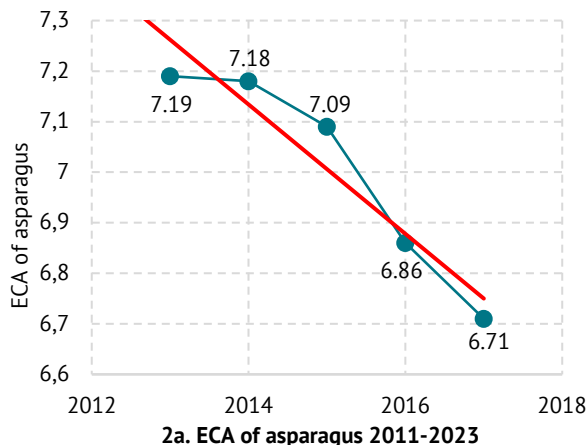


Figure 2. ECA of asparagus

Source: compiled by the authors

Asparagus was one of the first non-traditional foreign products to be adapted in the region, positioning itself in the United States (USA), followed by the United Kingdom, the Netherlands, Spain, Canada, and others. Its quality and good taste have enabled its exports to increase rapidly. High yields have consolidated Peru as one of the world's leading suppliers of asparagus, along with China and Mexico. The artichoke has a weak comparative advantage (ECA of 1.80), although it has an important presence in the international market, with a stagnant competitiveness trend in the last years of the period from 2018 to 2023 (Fig. 3). It is mainly exported in canned form or as whole pieces, with the main buyers being the United States, Spain, and France.

the period from 2012 to 2023 (Fig. 4). The product is exported preserved and ground. The main destinations are the USA, Mexico, Spain, Germany, and France.

Of the Capsicum genus, the piquillo pepper has had a mixed performance, with a decline in exports and restrictions on access to markets due to post-harvest contamination. However, the ECA index indicates its high competitiveness and the trend shows an increase over time. It is exported preserved and dried as a powder. For paprika pepper, competitiveness has decreased over

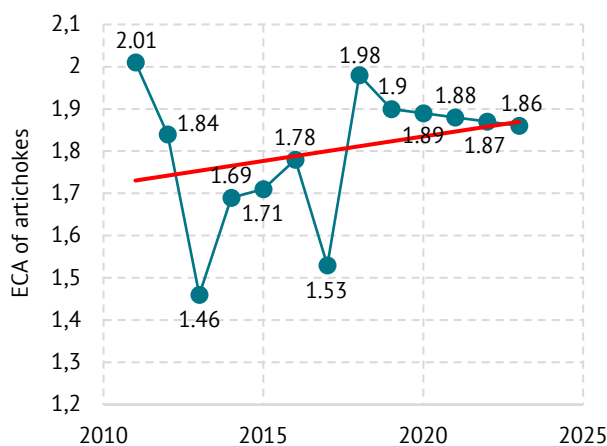


Figure 3. ECA of artichokes 2011-2023

Source: compiled by the authors

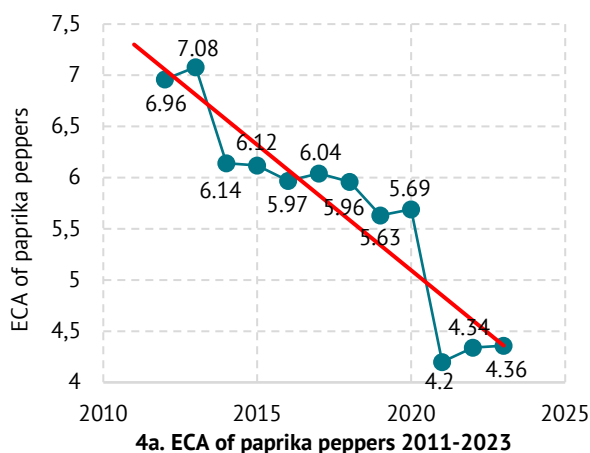
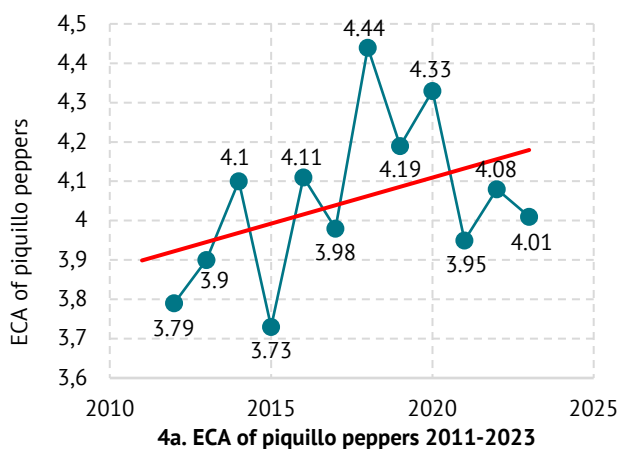


Figure 4. ECA of piquillo peppers and paprika peppers 2012 - 2023

Source: compiled by the authors

The RCA (Revealed Comparative Advantage) index for sugar was obtained by taking the difference between the ECA (Export Comparative Advantage) and ICA (Import Comparative Advantage) indices to determine whether the product has a revealed comparative advantage. Statistical information on sugar imports for the La Libertad region is not available, and the authors worked with data at the national level. This does not diminish the significance of the

results, as a large part of Peru's sugar production comes from this region (Flores *et al.*, 2022). Sugar has a positive RCA of 1.27, with positive ECA > ICA values, indicating a moderate comparative advantage of its exports; both are positive, meaning that the country's imports are important in internal trade. The trend of the ECA is increasing while that of the ICA is decreasing, although both exhibit fluctuations (Table 3, Fig. 5).

Product	ECA	ICA	RCA
Sugar	2.44	1.17	1.27

Source: compiled by the authors based on Trade Map (n.d.)

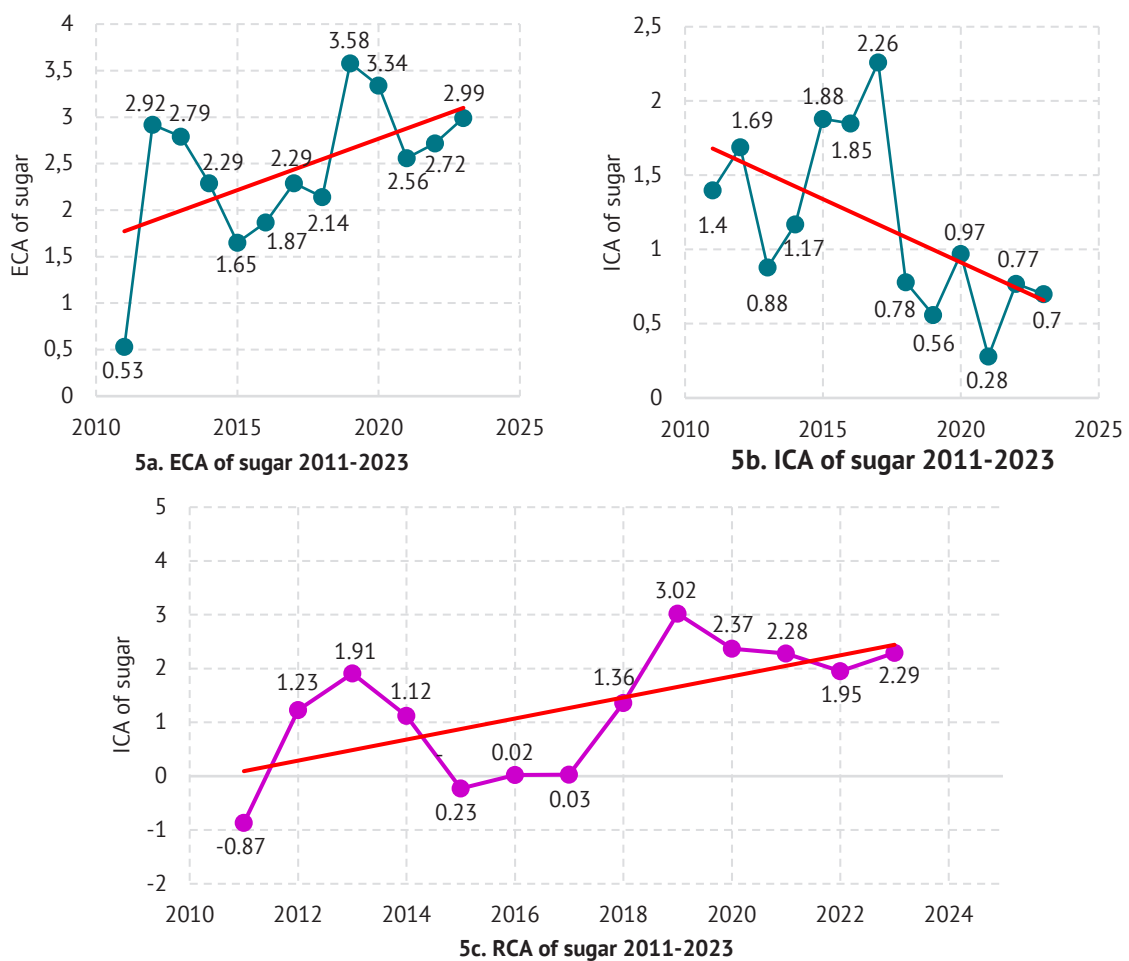


Figure 5. ECA, ICA, and RCA of sugar (2011-2023)

Source: compiled by the authors

**Export Comparative Advantage (ECA) of products by category.** Figure 6 analyses the products by category: fruits and vegetables. In the period 2011-2023, La Libertad showed an increasing competitive performance in fruits but was more stable in vegetables. From 2012 to 2016, vegetable exports dominated fruit exports; however, since 2019, fruits have

overtaken vegetables. This performance is explained by the expansion of blueberry production and exports led by La Libertad, alongside higher exports of avocados, grapes, and mangoes, which significantly increased overall fruit exports. International trade in fresh fruits and vegetables has become increasingly consolidated in recent decades in developed

countries due to sustained growth in consumption, which is attributed to changes in dietary preferences for health and aesthetics. In fresh fruit, exports grew significantly, especially of avocados, grapes, mangoes, mandarins, and blueberries, to the United States, the Netherlands, Spain, Chile, the United

Kingdom, Hong Kong, South Korea, China, Canada, Russia, and others (Duarte, 2019). For vegetables, the leading products were asparagus and paprika. As with fruits, the United States led the ranking in vegetables, followed by Spain, the Netherlands, France, and the United Kingdom, among others.

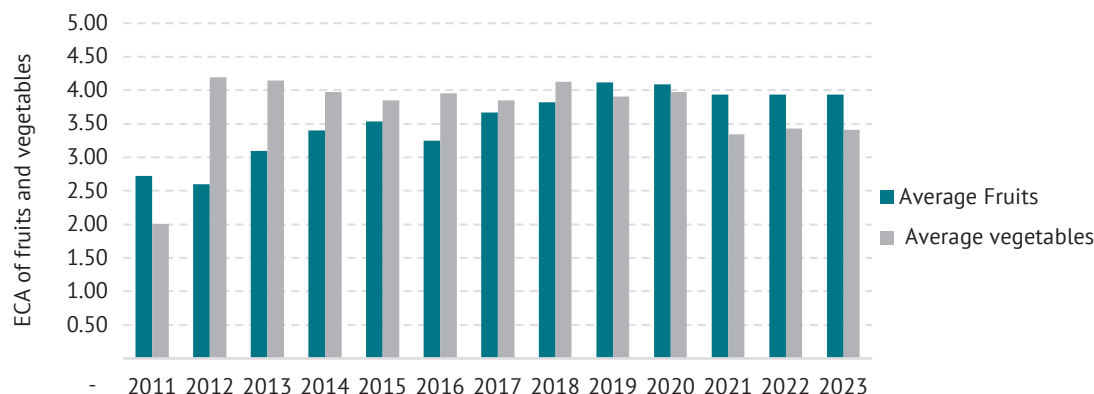


Figure 6. Fruits and vegetables ECA evolution 2011-2023

Source: compiled by the authors

Competitiveness is then addressed in terms of the specialisation and productivity of the region and the country.

**International Competitiveness, Specialisation, and Productivity.** In La Libertad, the products with a strong comparative advantage discussed in the

previous section – fruits (blueberries, avocados), vegetables (asparagus), and sugar cane – exhibit higher productivity than both Peru and several leading countries in the world. This is reflected in the position of Peru and La Libertad in the export ranking (Table 4).

Table 4. Export ranking of the main crops

Crop	Peru/ world	La Libertad/Peru (%)	The three most important exporting countries
Canned asparagus	2°	43.2	China (50%); Peru (36%); Netherlands (6%)
Fresh asparagus	2°	n.d.	Mexico (34%); Peru (30%); USA (11%)
Avocados	3°	31.6	Mexico (50%); Netherlands (11%); Peru (10%)
Canned artichokes	2°	14.0	China (41%); Peru (7%); Netherlands (6%)
Fresh blueberries	2°	54.0	Chile (19%); Peru (15%); Spain (13%)
Fresh grapes	6°	4.11	Chile (14%); USA (12%); Italy (9%)
Fresh mangoes	6°	1.20	Mexico (15%); Vietnam (12%); Netherlands (11%)
Paprika pepper	6°	0,0	China (39%); India (18%); Spain (18%)
Fresh watermelon	38°	52.6	Spain (22%); Mexico (15%); Iran (9%)
Sugar cane derivatives	62°	48.4	Brazil (16%); Thailand (10%); France (9%)

Source: compiled by the authors based on Trade Map (n.d.)

A region with high productivity is likely to be highly competitive due to its lower unit costs. This is clearly the case in La Libertad; if factor specialisation is added to the production of these goods, international competitiveness will be guaranteed. The methodology employed to estimate the competitiveness indices (ECA, ICA, RCA) is similar to that used by M. Anderson *et al.* (2021), who determined the revealed competitiveness of Peru and South America in the production of rice and potatoes. J. Heredia and J. Huarachi (2009)

evaluated the RCA for the Lambayeque region of Peru, using a larger sample of agro-industrial products and the index values for competitive products were of a higher magnitude than those obtained in this research for La Libertad.

**Determinants of the competitiveness of the region's agro-exports.** Once the competitiveness of La Libertad has been measured, it is also necessary to identify the factors that have enabled this success, as well as those that have constrained it. A descriptive analysis is



conducted of the main components that have facilitated the export of products which have established themselves in the international market, using the qualitative model (Inga-Ávila, 2022) known as Porter's Diamond. This considers: 1) factor conditions, 2) demand conditions, 3) related industries, and 4) the structure and rivalry within the industries – attributes that constitute the system referred to by Porter (1991) as the "Diamond". Two additional variables complete the framework of the analysis: government influence and random or causal events. The competitiveness of the export sector depends significantly on the quality of logistics infrastructure and services (World Bank, 2016). In La Libertad, there are deficiencies in road infrastructure and in the cargo capacity of ports and airports, which do not meet the demands of exporters. Moreover, there is a shortage of skilled workers in the digital technologies necessary to compete successfully with foreign companies. The paralysis of the third phase of the Chavimochic irrigation project is hindering the incorporation of 20,000 new hectares of crops and the enhancement of irrigation for the 50,000 hectares already under cultivation (SPCH, 2023). If these factors were strengthened, the productivity potential of the La Libertad region would be greater, and its competitiveness would be sustainable over time.

In summary, the analysis of the ECA indices from 2011 to 2023 reveals that La Libertad's agricultural exports exhibit notable competitive advantages. Both blueberries and avocados stand out with high ECA values, reflecting strong international competitiveness. Vegetables such as asparagus and paprika also demonstrate robust advantages, while watermelon and artichokes have weaker comparative positions. The trend analysis indicates that blueberries, avocados, grapes, and mandarins have generally become more competitive over the period, whereas mangoes, watermelons, and certain vegetables have seen a decline. The RCA index for sugar indicates a moderate competitive stance, with challenges in balancing exports and imports. Despite these competitive strengths, La Libertad faces significant obstacles, including infrastructure inefficiencies and logistical issues, which impact its overall competitiveness. These findings underscore the region's potential and highlight areas where improvements are necessary to sustain and enhance its agro-export sector.

The efficiency and simplicity of calculating the competitiveness indices (ECA, ICA, and RCA) for La Libertad in its agro-exports reflect the findings of S. Gariballa et al. (2023), who obtained these indices for rice and potatoes from Peru and South America and found that they were not competitive in these products. Likewise, the competitiveness of Peruvian agricultural products was also evaluated by D.A. Escalante et al. (2023), who compared the competitiveness of blueberries, grapes, avocados, coffee, and asparagus with products from other Latin American countries during the period 2010-2019,

analysing two categories: the degree of specialisation and the degree of competitiveness using the competitiveness matrix. They found a high degree of specialisation in Peruvian blueberries, grapes, and avocados; coffee and asparagus were the least competitive. Peru's competitive potential in blueberries was confirmed by C. Aggio et al. (2022) through a case study on blueberry producers in Argentina, which revealed that their strategy, based on achieving high prices out of season, was less efficient than that of Peruvian blueberry exporters. The study agrees with the findings of J.C. Montes Ninquispe et al. (2024) regarding the high competitiveness of Peru in blueberries. Regarding the importance of institutional factors, the findings of the research on the competitiveness of La Libertad align with those of H.-P. Feng et al. (2023), which indicated that membership in the European Union (28 members) positively impacted the economic development and competitiveness of all Union members. In contrast, C.E. Ospina et al. (2023) found that the Hass avocado system in Cauca improves its competitiveness through technological support driven by institutions and international cooperation, which favours producers' access to export markets.

In the specific case of rare earth industries, A. Thi-beault et al. (2023) point out that competitiveness is the fundamental framework for achieving the development of any industry and highlight the role of government in strengthening it, in line with Porter's thinking: information, incentives, competitive pressures, access to firms, institutions, infrastructure, knowledge resources, and management skills contribute to increasing competitiveness indicators. Each region has different comparative advantages due to climate, access to resources, technology, innovation, agricultural practices, and other factors. Competitiveness implies the efficiency of production, logistics management, and factors external to the firm, and it changes over time as it depends on the internal and external conditions in which firms operate (De & Singh, 2022).

C.E. Ospina et al. (2023) assess the avocado value chain in Valle del Cauca (Colombia), taking into account biophysical, social, economic, and technological factors. They found that the Hass avocado system in Cauca is heterogeneous and dispersed, with varying degrees of modernisation and articulation with markets. Moreover, technological progress is driven by institutions and international cooperation, which promotes access to export markets for small and medium-sized producers. To ensure the sustainability of an agro-export sector that is well positioned in the world market, it is necessary to understand its level of competitiveness, monitor its performance over time, and reduce the obstacles that hinder its improvement. J. Hancco (2022) found that strategic business management significantly impacts the competitiveness of 127 micro and small agro-export firms in Tacna, Peru. R. Ramos-Sandoval (2019) points out that the small size of Peruvian agribusinesses

could hinder their internationalisation by preventing them from achieving economies of scale and adopting technological innovations. On the other hand, recent popular protests against agro-exporters, alleging wage and labour productivity inequality in the sector (Castillo, 2021), align with the issues identified 30 years ago by M. Carter and D. Mesbah (1993), who found a link between agricultural export growth, land concentration, and labour instability.

M. Mills-Novoa (2020) critically points out that agricultural and water policies since 2009 have reallocated water to agro-export companies. It should be noted that agro-export crops generate a growing water footprint. In this context, X. Esteve-Llorens *et al.* (2022) observe that Peru exploits abundant groundwater for avocados and asparagus, but high-tech irrigation systems minimise water use, and low pesticide mobility prevents the degradation of natural water bodies. To alleviate the water deficit, desalination of seawater is a strategy employed in Greece (Panagopoulos & Giannika, 2023; Harati *et al.*, 2023). This could provide more water for agricultural irrigation, which could alleviate the water shortage in many areas of Peru, such as La Libertad. However, this could be further addressed through irrigation projects, which, although expensive, can be implemented over many years, as demonstrated by the Chavimochic project (SPCH, 2023). The Chavimochic project began in 1988 to harness the waters of the Santa River to meet the irrigation needs of 144,000 hectares in the Chao, Virú, Moche, and Chicama valleys. After the completion of the first and second phases, the irrigation of 28,000 hectares has been improved, and 46,665 hectares will be included in the Chao, Virú, and Moche valleys.

E. Roszko-Wójtowicz and M. Grzelak (2020) used macroeconomic variables to rank European Union (EU) member states by competitiveness and found that membership in the EU (28 members) had a positive impact on economic development and competitiveness in both the EU-13 (more developed) and the EU-15 (less developed) countries. Measuring competitive performance using comparative advantage indices from international trade is a practical way of determining whether a country or region has comparative advantages. P. Crupi *et al.* (2021) point out that competitiveness is measured by taking into account prices, exchange rates, production, financial, fiscal, and transport costs using the Export Competitive Advantage (ECA), Import Competitive Advantage (ICA), and Revealed Competitive Advantage (RCA). Y. Bahta (2021) evaluated South Africa's agri-food competitiveness with the RCA, the Lafay Index (LI), the Export Diversification Index (EDI), the Main Export Category (MEC), the Hirschman Index (HI), and the influence of factors using regression analysis. C. Aggio *et al.* (2022) used a case study of the blueberry agrosystem to assess Argentina's competitiveness in this product and found that its strategy, based on

achieving high prices out of season, was less efficient than that of blueberry exporters from Peru. Z. Tamar and A. López (2022) found that Mexico has RCA in 15 of the 37 major agricultural products of Mexico, the US, and Canada, from the period 1990-2017, with per capita income, total population, rural population, arable land, and agricultural capital as significant factors. D.A. Escalante *et al.* (2023) compared the competitiveness of the five main Peruvian products with similar products from other Latin American countries in the period 2010-2019, analysing two categories: the degree of specialisation and the degree of competitiveness using the competitiveness matrix. They found a high degree of specialisation in Peruvian blueberries, grapes, and avocados; coffee and asparagus were the least competitive. J.C. Montes Ninaquispe *et al.* (2024) applied a quantitative approach to evaluate the sustainability and competitiveness of Peru's blueberry exports. They calculated the Herfindahl-Hirschman Index (HHI) and the Balassa RCA index. They found very high growth in the United States (115% annually) and robust growth in the Netherlands and the United Kingdom. However, the HHI showed great dependence on the United States. The RCA indicated that Peru is competitive in blueberries compared to the United States (values ranging from 0.09 to 0.55 during the study period). In summary, the literature identifies competitive advantages for Peru in Peruvian agricultural products, and this is confirmed by the present work for the region of La Libertad, using a simple and research-friendly methodology such as that of revealed comparative advantages.

## CONCLUSIONS

The competitiveness indicators show that La Libertad's agricultural exports have comparative advantages and that specialisation is advantageous. The most competitive fruits are blueberries and avocados, and in vegetables, the most competitive are asparagus, artichoke, and paprika, which have the highest ECA indices. The least competitive fruits are mango, tangerine, grape, and watermelon, while for vegetables, the least competitive is piquillo pepper. The evolution of the competitiveness indices shows that blueberries, avocados, grapes, and mandarins have become more competitive over the period, while mangoes, watermelons and all vegetables except piquillo peppers have become less competitive. The RCA for sugar shows that it is weakly competitive, with a positive net value very close to zero, indicating that exports are moderately competitive but imports are also competitive in the domestic market. The competitiveness indices for exports and imports increase over the period studied, although the competitiveness of imports tends to increase faster than that of exports. In general, La Libertad is competitive in the fruit and vegetable trade because it has developed competitive advantages based on regional comparative advantages. However, there are still factors that affect business

logistics and increase the cost of products: the inefficiency and lack of capacity of the regional port and airport infrastructure, customs inefficiency, poor local road infrastructure, a lack of skilled workers in digital technologies, and the failure to complete the Chavimochic Special Project, which would integrate agricultural land and improve land irrigation.

Future research should delve into several important areas. First, it should explore how the increased competitiveness of La Libertad's agro-exports has influenced the regional economy. Additionally, investigating whether the growth in exports has had a positive impact on small-scale family farming is crucial. Understanding the potential for further expansion of La

Libertad's agro-exports and assessing the prospects for broadening the sector will provide valuable insights. Addressing these questions will be essential for refining strategies to boost competitiveness and tackle ongoing challenges in the agro-export sector.

### ACKNOWLEDGEMENTS

The authors would like to thank Ivanna Abigail Cubas Cubas, a student at the Faculty of Economics and Planning at the Universidad Nacional Agraria La Molina, for her help in designing and editing the figures.

### CONFLICT OF INTEREST

The authors declare no conflict of interest.

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## Конкурентоспроможність регіону Ла Лібертад в експорті сільськогосподарської продукції, Перу, 2011-2023

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**Анотація.** Зростання світового попиту на високовартісні сільськогосподарські продукти підкреслює необхідність розуміння конкурентоспроможності регіонального експорту. Мета полягала в тому, щоб оцінити порівняльні переваги La Libertad в експорті сільськогосподарської продукції за період 2011-2023 років. Використовуючи індекси виявленої порівняльної переваги (RCA), порівняльної переваги експорту (ECA), порівняльної переваги імпорту (ICA) і діаманта Портера, було досліджено показники регіону та детермінанти конкурентоспроможності в 11 ключових експортних продуктах, включаючи такі фрукти, як чорниця, авокадо, виноград і овочі, такі як спаржа та перець пікільо. Аналіз показує сильні ECA для фруктів і овочів, зі значеннями в діапазоні від 1,56 до 7,08, і життєздатну спеціалізацію на тростинному цукрі (RCA 1,28). Отримані дані показали, що більшість із цих продуктів мають значні або помірні порівняльні переваги на міжнародних ринках, причому такі продукти, як чорниця та авокадо, є лідерами за конкурентоспроможністю. Однак певні проблеми залишаються, зокрема потреба в стратегічному управлінні бізнесом і технологічних інноваціях для підтримки та підвищення конкурентоспроможності сектора. Дослідження підкреслює важливість постійного моніторингу та адаптації для забезпечення стійкості та зростання агроекспортного сектору Перу, а результати пропонують цінну інформацію для політиків і регіональних планувальників для підвищення експортного потенціалу сільськогосподарської продукції Ла Лібертад

**Ключові слова:** діамант Портера; фрукти та овочі; виявлені порівняльні переваги

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