Trade dependence of Mexico on barley (*Hordeum vulgare* L.)

Núñez-Betancourt, E.Y.[1]; Rivera-López, S.[2]; Luquez-Gaitan, Carlos E.[2]; Revilla-Chaviano, A.[1*]

[1] Universidad Politécnica de Texcoco. San Miguel Coatlinchán, Texcoco, Estado de México, México, C.P. 56250.
[2] Universidad Autónoma Chapingo. Carretera Federal México-Texcoco km 38.5, C. P. 56230 Texcoco, Edo. de México.
* Correspondence: barcarevilla@gmail.com

ABSTRACT
Objective: To determine the degree of trade dependence of the Mexican market on imported barley from 1994 to 2021.
Design/Methodology/Approach: The growth rates of the barley production variables in the domestic market were estimated, the relative trade balance was calculated, and the trade dependence was determined.
Results: The production variables had growth rates in the analysis period, the relative trade balance was −1, and the trade dependence was close to 0.
Study Limitations/Implications: There is no correlation between the barley market and the brewing industry in Mexico.
Findings/Conclusions: Mexico is a net importer of barley despite the positive growth rates of the production variables. Nevertheless, this grain does not have a trade dependence on the foreign market.

Keywords: Relative trade balance, trade dependence, growth rate, barley.

INTRODUCTION

Barley (*Hordeum vulgare* L.) is considered the oldest cereal in the world and has two points of origin: Southeast Asia and North Africa (Ponce *et al.*, 2020). In 2019, it ranked fourth in sown area, after wheat, corn, and rice. The largest planted areas are in Russia, Australia, Ukraine, Turkey, and Spain, while Mexico ranks in the 27th place (Tumuri, 2019). The use of this cereal in Mexico dates to the Spanish conquest, when it was used as forage for horses (Coronel and Jiménez, 2011).

Barley is used as a raw material for malt production, and it is also an important source of health-promoting components (Bragachini *et al.*, 2008). The Mexican brewing industry uses it to produce alcoholic beverages. It is a temporary and profitable crop that has a comparative advantage in both the regional and the international markets (De la Rosa *et al.*, 2016).

To determine its competitiveness, the comparative advantages of a product associated with natural factors must be considered (Contreras, 2000). Additionally, this is a core issue for governments and companies, because it is related to better living conditions (Ferraris, 2009). A nation's competitiveness is the result of industrial productivity, sustained exports,

Citation: Núñez-Betancourt, E.Y., Rivera-López, S., Luquez-Gaitan, C. E. & Revilla-Chaviano, A. (2024). Trade dependence of Mexico on barley (*Hordeum vulgare* L.). *Agro Productividad*. https://doi.org/10.32854/agrop.v17i1.2513

Academic Editors: Jorge Cadena Iñiguez and Lucero del Mar Ruiz Posadas

Received: February 13, 2023.
Accepted: December 17, 2023.
Published on-line: February 19, 2024.

Agro Productividad, 17(1). January. 2024. pp: 27-35.

and significant outflows of foreign investment (Porter, 2008). Market share is another useful competitiveness indicator (Mc Fetridge, 1995).

Competitiveness Indexes are values that measure the economic performance of a nation and reflect the variables that allow competitive performance (Murillo, 2005; Ibáñez and Troncoso, 2001). Comparative advantage forms the basis of exports (Ricardo, 1985) and understanding its nature is critical (Hosein, 2008), since this variable functions as a guide for trade and industrial policy (Huerta, 2009).

The theory of absolute advantage postulates that each country should specialize in producing the goods that they can make with greater efficiency under free trade (Smith, 1776). The absolute advantage proposed by Smith lacks two major elements that are basic for international trade nowadays: transportation costs and consumer preferences (Krugman *et al.*, 2012; Carbaugh, 2009; Appleyard *et al.*, 2006; Salvatore, 1997).

In Latin America, the importance of detecting sectors with advantage and disadvantage is essential for the optimal allocation of resources (Prebisch, 2008). The relative trade balance and the trade dependence must be calculated to analyze the competitiveness of the Mexican agricultural sector (Luquez, Gómez, and Hernández, 2021; Luquez, Gómez, and Hernández, 2022; Luquez, Hernández, and Gómez, 2022).

The objective of this research was to determine the degree of trade dependence of the Mexican market with respect to imported barley from 1994 to 2021. The research hypothesis was that the Mexican market is self-sufficient and does not depend on foreign barley markets, despite trade openness and the North American Free Trade Agreement (SE, 2019).

MATERIALS AND METHODS

The barley production variables were consulted in the Sistema de Información Agroalimentaria de Consulta (SIACON), while international trade statistics were obtained from the Food and Agriculture Organization of the United Nations (FAOSTAT).

The growth rates of the production variables were calculated, and the global competitiveness indexes were estimated: relative trade balance and trade dependence. The following concepts and formulas were used for this purpose:

Growth rate: the percentage increase or decrease that a given value has in a period (Brambila, 2011). The calculation procedure was:

$$r_{(1-n)} = \left[\left(\frac{V_n}{V_1}\right) - 1\right] * 100 \qquad (1)$$

Where: $r_{(1-n)}$: growth rate from year 1 to year n; n: number of years; V_n : value in year n; V_1: value in year 1.

A positive value of the growth rate implies that the variable grew in the period analyzed, while a negative value implies that it decreased.

Trade balance: a financial indicator that measures the relationship between exports and imports (WTO, 2015). It was calculated using the following formula:

$$BC = X - M \tag{2}$$

Where: *BC*: trade balance; *X*: exports; *M*: imports.

A trade surplus is recorded when exports are greater than imports in the trade balance. Otherwise (*i.e.*, if imports are greater than exports), there is a trade deficit.

Relative trade balance (**RTB**): an indicator that measures the relationship between the trade balance of a product and the total trade of the same product for a country in the world market or in a specific market. It is interpreted as an index of competitive advantage (García, 1995) and was calculated with the following formula:

$$BCR_{ij} = \frac{X_{ij} - M_{ij}}{\left|X_{ij} + M_{ij}\right|} \tag{3}$$

Where: BCR_{ij}: relative trade balance of country *j* with respect to product *i*; X_{ij}: exports of product *i* by country *j* to the world market; M_{ij}: imports of a product *i* by a country *j* from the world market.

If the RTB ranges from −1 to 0, the country is a net importer of the product and lacks a competitive advantage. If the RTB ranges from 0 to 1, the country is a net exporter of the product and has a competitive advantage.

Trade dependence: coefficient that calculates the relationship between the value of imports (M) and the value of apparent consumption (AC) during a given period. This indicator measures international competition for domestic demand (Ramírez *et al.*, 2016), using the following formula:

$$GI_{ij} = \frac{M_{ij}}{Q_{ij} + M_{ij} - X_{ij}} \tag{4}$$

Where: GI_{ij}: degree of penetration of product imports *i* in country *j*; M_{ij}: imports of product *i* from country *j*; Q_{ij}: domestic production of product *i* of country *j*. X_{ij}: exports of product *i* from country *j*.

If the coefficient is close to 0, the competitiveness of the sector or productive chain is greater, while, if it is close to 1, the competitiveness of the sector or productive chain is lower.

RESULTS AND DISCUSSION

The surface of Mexico where barley was sown and harvested increased in the analysis period, recording a growth rate of 138% and 177%, respectively. Specifically, a marked increase was observed from 1994 to 2003. From this date, the surface sown with barley has maintained a trend of small fluctuations (300,000 to 330,000 ha). For its part, the harvested surface showed large fluctuations, mainly in 2000, 2004, 2009, 2011, and 2013 (Figure 1).

During the analysis period, the barley yield in Mexico has been very unstable. For example, in 2003 and 2016, it reached 3.0 t ha^{-1} while in most years (since 1994), it has remained around 2. 5 t ha^{-1} showing a stable trend (Figure 2).

The total production of barley in Mexico recorded a >200% increase from 1994 (315,000 tons) to 2021 (>1,000,000 tons). However, important peaks in production were recorded, including increases in 2003, 2012, 2017, and 2018 in which >1 million tons were produced (Figure 3).

The Mexican market is not a major barley exporter: it reached the highest number of grain exports of the study period in 2014 (942 t) and an all-time low exportation level in 2010 and 2012 (169 t and 161 t, respectively). In 1996, Mexico imported more than 300,000 tons of barley —the largest volume imported in the period under analysis. However, the largest volume of cereal purchased in the last decade was 169,000 tons in 2015; in comparison, only 214 tons were purchased in 2018. Therefore, the trade balance of the product recorded a trade deficit during the period of analysis (Figure 4).

The relative trade balance ranges from −1 to −0.6 (Figure 5): Mexico is a net importer and lacks competitive advantages in the international barley market. The indicator usually has a value of −1, which proves that the production is not enough to supply the domestic demand.

Trade dependence was estimated between 0 and 0.4, which implies that the Mexican market is not dependent on the international barley market. Since 2000, this indicator has remained below 0.2 (Figure 6), confirming the previous observation. In 2017 and 2018, the value of this coefficient was practically null.

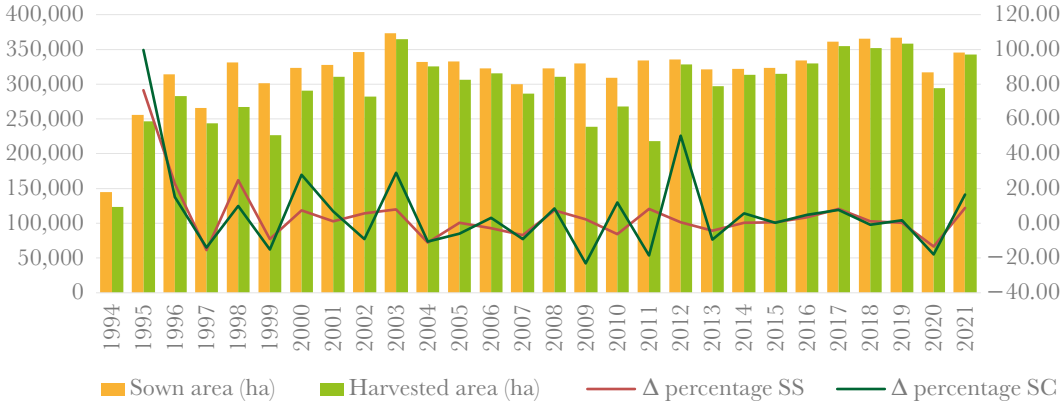

Figure 1. Behavior of the surface where barley was sown and harvested. Source: figure developed by the authors based on data from SIACON (2022).

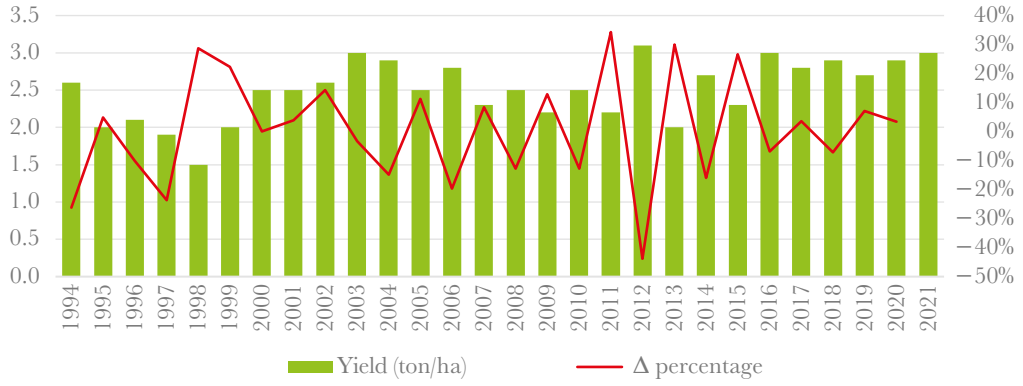

Figure 2. Barley yield in Mexico. Source: figure developed by the authors based on data from SIACON (2022).

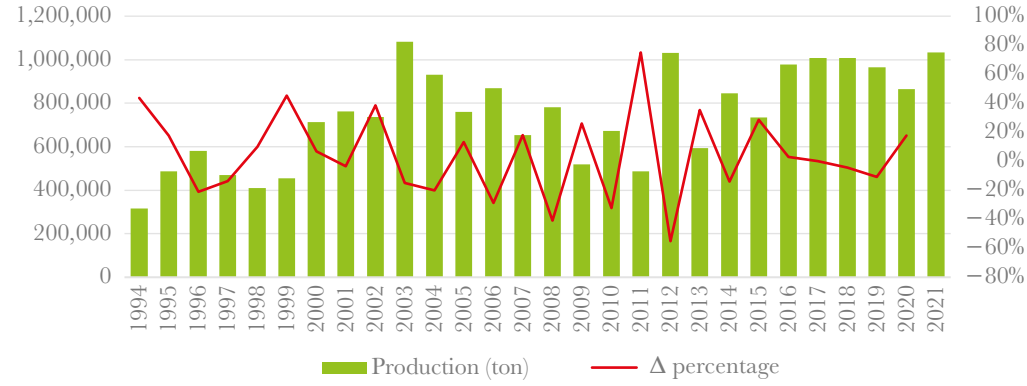

Figure 3. Volume of barley production in Mexico. Source: figure developed by the authors based on data from SIACON (2022).

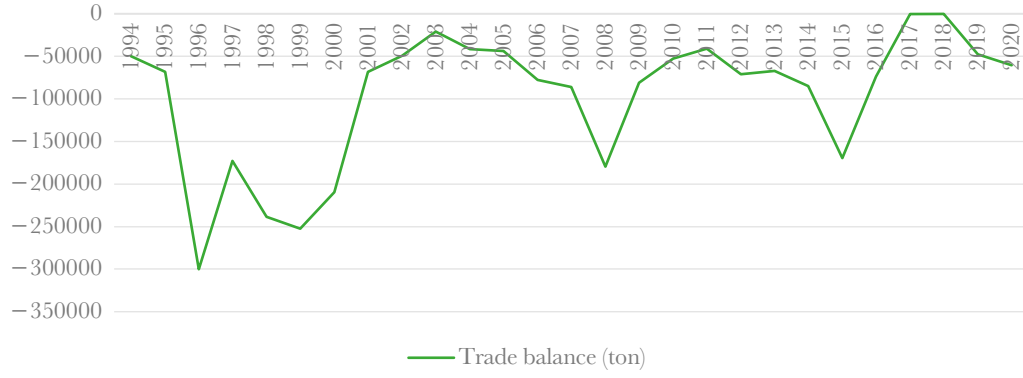

Figure 4. Trade balance of barley in Mexico. Source: figure developed by the authors based on data from FAOSTAT (2022).

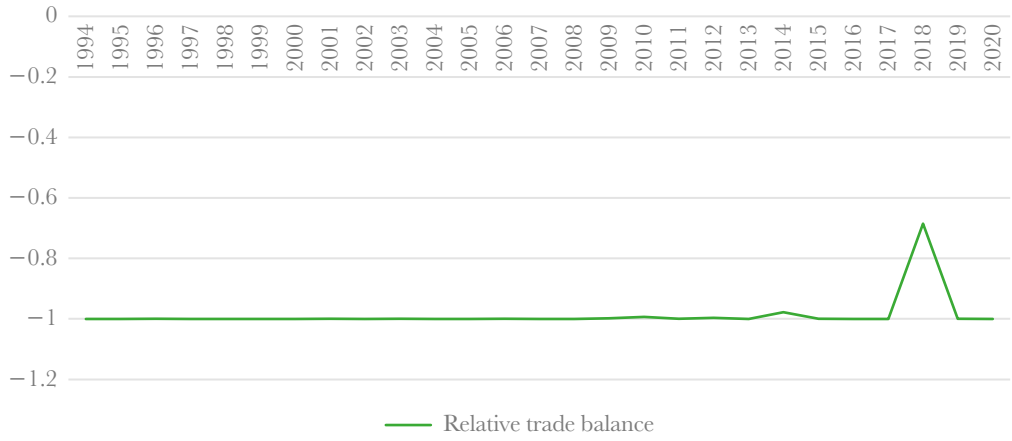

Figure 5. Relative trade balance of barley in Mexico. Source: figure developed by the authors based on data from FAOSTAT.

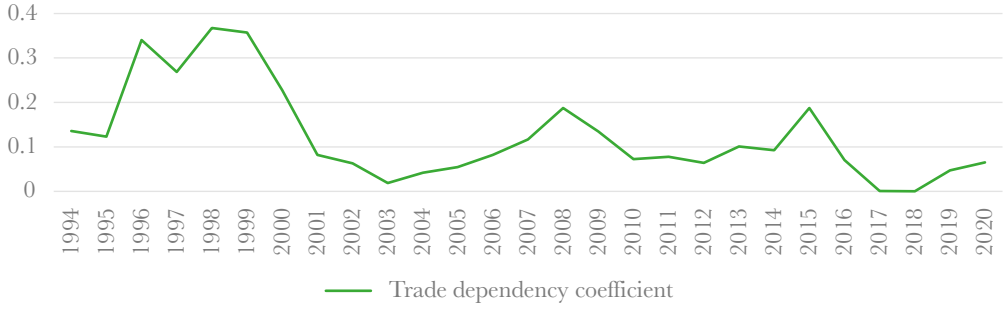

Figure 6. Trade dependence of barley in Mexico. Source: figure developed by the authors based on data from SIACON and FAOSTAT.

CONCLUSIONS

The surface in which barley was sown and harvested in Mexico increased in the period analyzed, the crop yield was stable, and the production volume tripled. However, exports were almost null, while imports have accounted for ~15% of the production volume.

The competitiveness indexes show that Mexico is a net importer of barley; however, the Mexican market is not commercially dependent on the international barley market, since national production is enough to supply domestic consumption.

REFERENCES

Appleyard, D., Field, A., (2006). International Economics. The McGraw-Hill companies, New York. 9th Edition.

Brambila, J. (2011). Bioeconomía: instrumentos para su análisis económico. Sagarpa /Colpos. Mèxico. Disponible en: http://repiica.iica.int/docs/intranet/Bioeconomia.pdf

Bragachini, M., Méndez, A., Scaramuzza, F., Vélez, J., Villarroel, D., Massigoge, J. (2008). Análisis del rendimiento y la calidad de la cebada cervecera en función de la profundidad de tosca en el perfil del suelo. Argentina: Instituto Nacional de Tecnología Agropecuaria, Recuperado de https://inta.gob.ar/sites/default/files/script-tmp-inta-analisisrendimiento-y-calidad-cebada-cervecera.pdf

Carbaugh, R. (2009). Economía internacional. (Doceava edición), Cengage Learning, México. Disponible en: https://iesfi.com/wp-content/uploads/2018/11/Economiainternacional.pdf

Contreras, J. (2000). "La competitividad de las exportaciones mexicanas de aguacate: un análisis cuantitativo", Agronegocios. Disponible en: http://www.avocadosource.com/wac4/wac4_p393.pdf

Coronel, J., & Jiménez, C. (2011). Guía práctica para los productores de cebada de la Sierra Sur. Disponible en: https://repositorio.iniap.gob.ec/bitstream/41000/1106/1/404.PDF

De la Rosa, A, Cruz N y Narváez, A. (2016). La producción de cebada maltera (Hordeum vulgare L.) en la región de Apan, Hidalgo. Ciencias de la Economía y Agronomía. Handbook T-II.-©ECORFAN. Disponible en: https://www.ecorfan.org/handbooks/Ciencias%20de%20la%20Economia%20y%20Agronomia%20T-II/HCEA_TII_5.pdf

FAO. (2022). Food and Agriculture Organization. Recuperado el 04 de Mayo de 2022, [Banco de datos]: https://www.fao.org/faostat/es/#data/QCL

Ferraris, G. (2009). Fertilización nitrogenada de trigo y otros cereales de invierno. Criterios de manejo para incrementar su eficiencia. Disponible en: https://www.fertilizar.org.ar/subida/revistas/Articulos/2009/2009%20-%20n%C2%BA%2011%20-%20Fertilizaci%C3%B3n%20nitrogenada%20de%20trigo%20y%20otros%20cereales%20de%20invierno.pdf

García R. (1995). Metodología para elaborar perfiles de competitividad del sector agroalimentario. Apoyo al comercio y a la integración en el área andina. Documento de trabajo. Caracas, Venezuela: IICA. http://repiica.iica.int/docs/B0241e/B0241e_49.html

Hosein, R. (2008). The evolving pattern of trade in a small hydrocarbon exporting economy and some policy recommendations for sustainable development. *Journal of Business, finance & Economics in Emerging Economies, 3*(1), pp. 121-154. Disponible en: https://cert-net.com/files/publications/journal/2008_1_3/121_154.pdf

Huerta, R. (2009). Ventajas comparativas y política industrial en una economía abierta. *Investigación Económica, 68*(269), pp. 113-141. Disponible en: http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0185-16672009000300004

Ibáñez C. y C. Troncoso. (2001). Algunas teorías e instrumentos para el análisis de la competitividad. IICA, San José, C. R. 74 pp. https://repositorio.iica.int/bitstream/handle/11324/9884/BVE20057994e.pdf?sequence=1&isAllowed=y

Krugman, P; M Obstfeld. y M. Melitz (2012), Economía internacional, teoría y política. Novena edición Madrid, Pearson educación. Disponible en: https://fad.unsa.edu.pe/bancayseguros/wp-content/uploads/sites/4/2019/03/Krugman-y-Obstfeld-2006-Economia-Internacional.pdf

Luquez Gaitan C. E., Gómez Gómez A. A., y Hernández Mendoza N. (2021). Análisis del acuerdo de asociación entre México y la Unión Europea y su impacto en la exportación de flores de 2001 a 2018. *Revista De Geografía Agrícola*, (66), 167-197. https://doi.org/10.5154/r.rga.2021.66.08

Luquez Gaitan, C. E., Gómez-Gómez, A. A., & Hernández-Mendoza,. N. (2022). International positioning of Mexican mango, analysis of foreign trade competitiveness indices from 2005 to 2018. *Agro Productividad*. https://doi.org/10.32854/agrop.v15i4.2116

Luquez Gaitan, C. E., Hernández Mendoza, N., & Gómez Gómez, A. A. (2022). Análisis de la competitividad comercial de aguacate entre México y la Unión Europea de 2001 a 2018. *Revista mexicana de ciencias agrícolas, 13*(3), 567–575. https://doi.org/10.29312/remexca.v13i3.2679

Mc Fetridge D. G. (1995). Competitiveness: Concepts and Measures, Occasional Paper No. 5, Canada: Carleton University, 33 pp. Disponible en: https://publications.gc.ca/collections/Collection/C21-23-5E.pdf

Murillo, D. R. (2005). Sobre el concepto de competitividad. *Revista de la CEPAL*. Disponible en: http://revistas.bancomext.gob.mx/rce/magazines/76/1/David_Romo.pdf

Organización Mundial del Comercio (OMC) 2015. https://www.wto.org/indexsp.htm.

Ponce-Molina, L., Noroña, P., Campaña Cruz, D. F., Garófalo, J., Coronel, J., Jiménez, C., & Cruz, E. (2020). La Cebada (*Hordeum vulgare* L.): Generalidades y variedades mejoradas para la Sierra Ecuatoriana. Disponible en: https://repositorio.iniap.gob.ec/handle/41000/5587.

Porter, M.E. (2008) The Five Competitive Forces that Shape Strategy. *Harvard Business Review*, 86, 79-93. https://www.scirp.org/(S(lz5mqp453edsnp55rrgjct55))/reference/ReferencesPapers.aspx?ReferenceID=2092246

Prebisch, R. (2008). Hacia una teoría de la transformación. *Revista de la CEPAL*, (96), pp. 27-71. Disponible en: http://hdl.handle.net/11362/11280

Ramírez-Padrón, L.C.1; Caamal-Cauich, I.1*; Pat-Fernández, V.G.1; Martínez-Luis, D.2. (2016). Índices de competitividad de la fresa (*Fragaria vesca* L.) de Mèxico en el mercado mundial. *Agroproductividad*. Mèxico. https://www.colpos.mx/wb_pdf/Agroproductividad/2016/AGROPRODUCTIVIDAD_V_2016.pdf

Ricardo, D. (1985). Principios de Economía Política y tributación. México: Ed. Piramide. Disponible en: https://www.ehu.eus/Jarriola/Docencia/EcoInt/Lecturas/David%20Ricardo_Principios_VII_Comercio%20exterior.pdf

Salvatore, D. (2005). Economía Internacional (Octava edición), Limusa Wiley, México. Disponible en: https://ccsuniversity.ac.in/bridge-library/pdf/Dominick-Salvatore-International-Economics.pdf

Smith Adam (1776), Investigación sobre la naturaleza y causas de la riqueza de las naciones (1983), Ediciones Orbis, S.A., Barcelona, Libro IV, capítulo II, sección I. https://repositorioinstitucional.buap.mx/handle/20.500.12371/4443

Secretaría de Economía (2019). TLCAN: Inicia el año 26 de su entrada en vigor. gob.mx. Recuperado el 26 de octubre de 2022, de https://www.gob.mx/se/prensa/tlcan-inicia-el-ano-26-de-su-entrada-en-vigor

SIACON (2022). (Sistema de Información Agroalimentaria de Consulta). Banco de datos. Disponible en: https://www.gob.mx/siap/prensa/sistema-de-informacion-agroalimentaria-de-consulta-siacon

SIAP. (2022). Servicio de Información Agroalimentaria y Pesquera. Obtenido el 02 de septiembre de 2022 de Servicio de Información Agroalimentaria y Pesquera. Banco de datos. Disponible en: https://www.agricultura.gob.mx/datos-abiertos/siap

SIAVI. (2022). Sistema de Información Arancelaria Vía Internet. Obtenido (04 de octubre de 2022) de Sistema de Información Arancelaria Vía Internet: https://www.snice.gob.mx/cs/avi/snice/informacionarancelaria.html

Tumiri, E. 2019. Comportamiento productivo de cebada (Hordeum vulgare L.) en dos cortes con riego por aspersión con la aplicación de Biol Bovino en la Estación Experimental Choquenaria.) *Revista de la Carrera de Ingeniería Agronómica – UMSA. Bolivia*. Disponible en: https://apthapi.umsa.bo/index.php/ATP/article/view/23