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Value chain analysis of cheese production in the municipality of Aculco (State of Mexico) Mexico

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ABSTRACT

Objective: to analyze the value chain of cheese production at the municipality scale, through a mixed approach combining the general guide, for evaluating value chains development, with the specific approach from a business perspective.

Design/Methodology/Approach: the integration of both approaches allowed for a systemic analysis incorporating social and business dimensions. Main social actors, relationships and bottlenecks —congested points such as operations, specialized work force, or transport— along the chain were identified. Those processes that generate value and determine competitiveness in the local context were highlighted.

Results: the value chain of cheese production in Aculco shows highly artisanal specialization, strong cultural roots, and significant contribution to local development. However, through the SWOT analysis, we found this production chain faces limitations in the articulation among producers, scarce innovation, and vulnerability to external economic and political factors. The mixed approach in this study conformed a methodological reference which can be applied to other agrifood systems to identify and strengthen organizational and business management capacities.

Limitations/Implications of the study: the analysis was limited to a specific municipality (Aculco, State of Mexico, Mexico) and results must be interpreted within that territorial scope. However, as a methodological reference it is applicable to other production chains, in localities with similar characteristics.

Findings/Conclusions: the value chain of cheese production in Aculco has both economic and cultural values, which make it a suitable option for the development of the local population. It is necessary to promote territorial integration and encourage sustainable practices that allow producers to foresee strategic scenarios in order to be adapted to changes in the environment.

Keywords: food security, productive integration, territorial development, SWOT analysis, mixed approach for value chains.

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INTRODUCTION

Milk production has been widely studied from several technical, social and economic approaches. Those include production systems, feeding, genetic improvement, animal

health, public policies, product quality, and marketing mechanisms, as well as their role for food security. However, the analysis of production linkage and the consolidation of the value chain have received less attention. In Mexico, the Economic Commission for Latin America and the Caribbean-ECLAC identified that dairy sector is dominated by micro, small, and medium-sized family enterprises, where an increase in the added value generates multiplier effects throughout the production chain (De Groot, 2018).

The United Nations Food and Agriculture Organization-FAO (2024) defines the dairy production chain as an integrated system of interdependent activities. These activities fulfill economic and social functions, hold a key role in the management of health risks and in the transition to sustainable systems. In the dairy sector, competitiveness depends on a holistic view of the production chain and the efficient use of resources, rather than on isolated capital investments (Cravero & Montagna, 2020).

In Mexico, the dairy sector contributes about 17% of the value of livestock production and 6% of the GDP of the food industry according to Mexico's National chamber of milk industry owners-CANILEC (2024). Industrial cheese production reached 632 895 tons (Megagrams, Mg) in 2023 according to data from Mexico's National Institute of statistics and geography (INEGI, 2024). In the State of Mexico, annual consumption *per capita* is 117 kg, supplied mainly by the Aculco-Polotitlán-Jilotepec basin, which generates 23% of state production. Aculco, the head municipality, is paramount with an annual production of 142 616 Mg of cheese at a 9.79% average growth between 2006 and 2023, according to the Department of Agriculture in the State of Mexico (SECAMPO, 2024).

From a localized Agri-Food Systems approach, territorial links integrate production, processing and marketing, although small producers tend to operate in a fragmented way, limiting the generation of collective value (Macías, 2019).

In this context, the objective was to analyze the value chain of cheese production at the municipality scale, through a mixed approach combining the general guide, for evaluating value chains development, with the specific approach from a business perspective.

MATERIALS AND METHODS

Data collection

The information was collected during January to July 2024 through the panel technique that was applied to milk producers, cheese makers, vendors and tourism service providers in the municipality of Aculco, State of Mexico. This made it possible to obtain information on the productive, commercial and service interactions, as components of the value chain. The subsequent analysis in this study was done with the General Guide for the Development of Value Chains (Nutz & Sievers, 2016), complemented with the value chain methodology (Porter, 1985) from a business perspective. Both methodologies share a systemic and strategic approach, which made it possible to comprehensively address the structure, interactions and dynamics of the value chain of cheese production in the municipality of Aculco (State of Mexico), Mexico.

Then, the SWOT analysis of the local production and marketing system of milk and cheese in the municipality was developed to evaluate production development in regard to internal strengths and weaknesses, along with external opportunities and threats. Finally,

the information obtained from the mixed approach was integrated to discuss and make the analysis specific from the business perspective.

RESULTS AND DISCUSSION

The cheese production sector was identified as a strategic axis of local development, as its capacities became visible, to articulate economic activities, generate employment and strengthen the territorial identity in the municipality of Aculco.

In the production chain, we first identified input suppliers of livestock feed and veterinary services, which are essential for productive and health sustainability. Milk producers are the generating nucleus of the raw material; while the intermediate link —represented by the boteros, the large volume transporters— articulates the collection, transport and distribution to the transformation units. From this point, the chain bifurcates into formal cheese production, with sanitary controls and standardized processes; and informal production, based on artisanal practices and minimum technified operation.

Both flows require transformation, packaging processes and packaging materials to ensure product quality. Finally, commercial intermediaries link production with markets and the final consumer. The chain has a heterogeneous and multi-sectoral structure, where processes of value addition and risk transfer are concentrated. Value chain operation is supported by an institutional component that includes Government agencies, support programs, as well as research institutions and technical advisors that facilitate the transfer of knowledge and innovation. We present the SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats) of the local milk and cheese production chain, as well as the marketing system in the municipality of Aculco (Table 1).

Table 1. SWOT analysis of the local production and marketing system of milk and cheese in Aculco (State of Mexico) Mexico.

Strengths	Opportunities
• Territorial recognition of the municipality as a specialized producer of milk and cheese. • Designation of "Magical Town", a Mexican socio-cultural label which reinforces cultural and gastronomic identity promoting tourism. • Availability of government programs aimed at strengthening agrifood production and tourism. • Presence of local and regional suppliers that foster productive linkage and territorial integration.	• Consolidation of a consistent brand image with regional and state-wide projection. • Comprehensive implementation of food safety and traceability measures throughout the value chain. • Adoption of technological and organizational innovation to enhance efficiency and competitiveness. • Certification on official quality and proven safety of products, that strengthen consumer confidence. • Growth of tourism-related business units through the diversification of value-added products.
Weaknesses	**Threads**
• Lack of a consistent product offer and a consolidated collective brand. • Absence of administrative control and accounting records within production units. • Lack of systematic monitoring of milk quality and overall quality of the final product. • Reduction of public resources allocated to production support and infrastructure. • Insufficiency in the quantity of technical workers hired and trained in management, safety and marketing. • Lack of a defined consumer profile and scarce strategies on territorial-segmented marketing.	• Climate change effects, including erratic rainfall and decreased forage productivity. • Reduction of subsidies for fertilizers, seeds and livestock inputs. • Price fluctuation of essential inputs for production. • Deficient tourist signage and insufficient access and service infrastructure. • Absence of clearly defined market niches. • Risk of a decrease in product quality, undermining the customer-quality relationship.

The cheese value chain in Aculco (Figure 1) represents the functional and regulatory scheme of the local production system, integrating processes, actors, institutions and regulations at four interrelated levels. The first level describes the production sequence, from cattle breeding and milking to the production, distribution, marketing of cheese and their eventual exports, so reflecting a local agrifood system oriented to internal and external markets.

The second level corresponds to support institutions, such as the Aculco City Council, Mexico's Secretariat of Agriculture (SADER), Mexico's Secretariat for Tourism (SECTUR), and a Magical Town denomination Promotion Committee. All of which provide training, technical assistance, and commercial promotion to producers, and micro-scale, small-scale or medium business, called in Mexico "MiPyMES" (Vilchis-Granados *et al.*, 2024). The central level integrates the production chain, with differences between formal and informal production. In the latter, family labor and seasonality influence the stability of the system. At the baseline level are the official standards that regulate quality and safety, to guarantee the traceability and competitiveness of the local production system.

In the analysis of the cheese value chain, two types of producers were identified: small producers and semi-industrial producers. Small-scale producers, both milk and cheese, produce with low levels of technified operation and standardization; have limited administrative and financial knowledge; and depend mainly on family labor. These conditions, together with the persistence of traditional practices, restrict productivity and affect product quality. One of the main challenges is to ensure the quality of the milk from milking, since producers deliver it to the boteros without applying quality and safety standards. Then, the latter operate with frequent interruptions in the cold chain during transport.

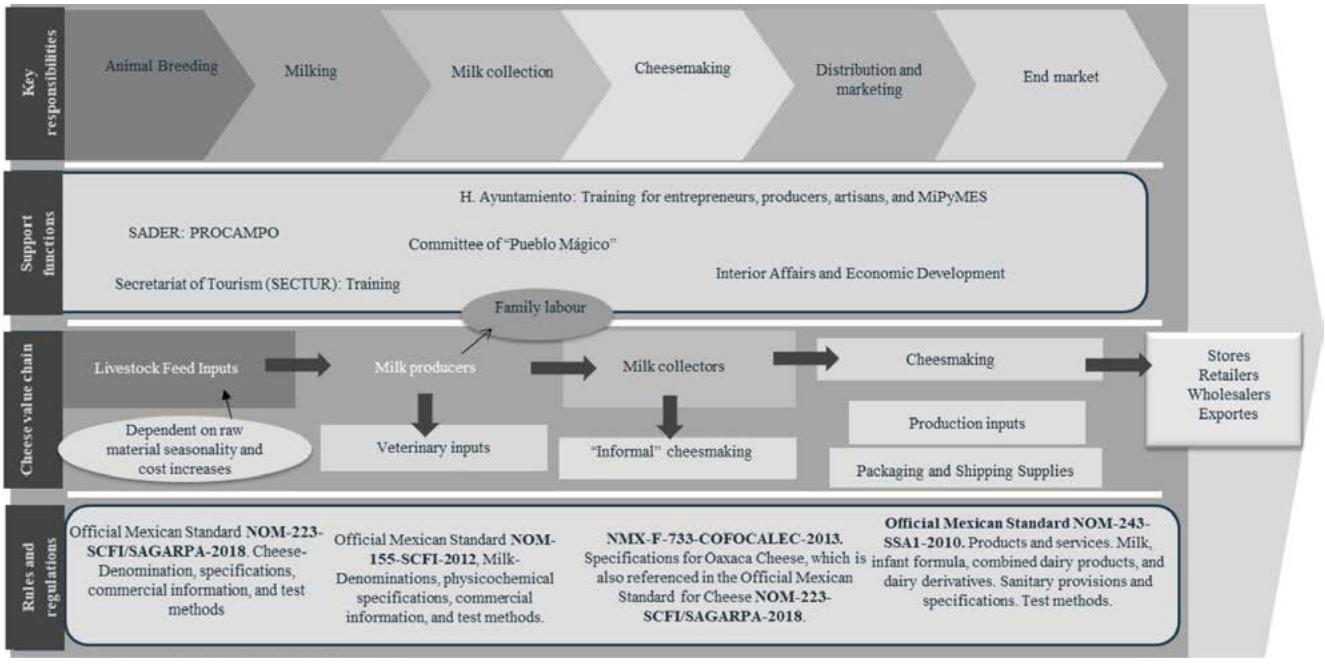

Figure 1. Functional structure and institutional framework of the cheese value chain in Aculco (State of Mexico) Mexico.

Semi-industrial producers have incorporated improvements in sanitary control and production processes; however, in some cases they resort to the use of non-dairy additives to increase the yield of the cheese. Although there are efforts for continuous improvement, technical and management limitations persist, especially affecting exporters, who face greater demands for product quality and traceability. Poor knowledge in Administration management limits access to credits, innovation and training in key areas such as genetics, health and quality. Likewise, the absence of nutritional labels and origin denomination, associated with the requirements of wholesalers, generates market asymmetries and hinders the construction of a territorial identity, which is in turn aggravated by the weak coordination among social actors.

Support actions from the municipality have been punctual and limited in scope. Among those, the Aculco Cheese Festivals are outstanding, since they generated local income increases and tourism promotion. Some producers have created micro-business with a presence on digital social networks; however, the lack of commercial planning reduces their consolidation. At the same time, agrifood tourism initiatives, such as those promoted by "Xplora Aculco", link cheese production with tourist activities, favoring economic diversification and the territorial visibility of the dairy cheese system.

According to Porter (1985), the value chain aims to optimize production efficiency, increase profitability, improve quality, foster innovation and promote product differentiation. In the case of the Aculco dairy cheese system, the production structure presents significant limitations in the articulation of social actors, and a weak functional integration between the different elements of the chain, which restricts the generation of added value and the competitiveness of the system.

The milk value chain in Aculco is characterized by a marked segmentation between primary production and cheese processing. In the initial stage, small-scale producers predominate, who produce with low levels of technified operation, limited infrastructure for cooling milk and limited administration management capacities. The marketing of milk mainly occurs through local intermediaries, without formal quality control mechanisms or traceability, which prevents the establishment of stable links with processors and limits the possibilities of differentiation in the market. On the other hand, artisanal and semi-industrial processors constitute the link with the greatest potential for value addition. However, this development is restricted by the lack of coordination with primary producers, the lack of common quality standards, and weaknesses in trade promotion strategies. This disconnection between primary and support activities reflects a fragmented performance of the production system.

From the analytical perspective of Crespo *et al.* (2014) and Hidalgo-Milpa *et al.* (2016), the value chain shows a system with a low level of technified operation, plus fragmented economics dynamic between producers, collectors, and processors (García-Villegas *et al.*, 2021). The business infrastructure is mostly composite of productive units located in domestic spaces, without formal administration or financial records, which limits planning, control of costs, and strategic decision-making. Human resources management is mainly based on family or informal labor, without systematic training processes for building technical and administrative capacities. In the technological aspect, equipment is reduced to basic

stainless-steel containers and stations, without incorporating productive innovations that improve efficiency or safety. Likewise, the supply of forage inputs, particularly during the dry season, revealed limited planning and a high dependence on external resources.

Analysis of primary activities reveals structural weaknesses in internal and external logistics. The availability of milk depends on the small number of producers, which limits the volume and quality of the input, while marketing channels are concentrated in local and regional markets, without formal distribution, positioning or loyalty strategies. Marketing actions are incipient and lack systematic records of sales and consumer feedback, making continuous improvement difficult.

Overall, the cheese value chain in Aculco operates in a fragmented manner and with little coordination between actors. Although productive units have the potential to promote local development, the lack of standardization, administrative controls, and differentiation strategies restricts their insertion in broader markets. As Durán-Rojas (2020) stated, greater articulation between actors is key to improving competitiveness. However, in contexts such as Aculco, this integration is limited by the lack of an associative culture that allows taking advantage of synergies, economies of scale, and strengthening the sustainability of the production system.

The intervention model for the development of value chains (Figure 2) proposes a comprehensive scheme aimed at strengthening the technical, organizational and commercial capacities of small cheese producers in the municipality of Aculco. This model emphasizes the need to implement comprehensive strategies to overcome structural deficiencies and enhance the competitiveness of the production system (Oddone & Padilla, 2017). Through its implementation, output, results, and impact stages, the model seeks to optimize inputs and productive activities in order to generate synergies that strengthen the profitability and sustainability of the system. Training, access to markets, and financing were considered as strategic axes, these understood as enabling conditions for effective inclusion in the value chain. The approach is based on the methodology of value chain analysis and responds to the main challenges identified in the previous diagnosis. Among those are the low technified operation, the weak articulation among social actors, the limited administration management and the scarce differentiation of products (Porter, 1985).

In accordance with ECLAC (CEPAL, 2014), it is recognized that small-scale producers have a high potential for the generation of employment and the economic revitalization of rural areas. This is particularly relevant in the agro-industrial transformation of milk, which can generate between four and 17 jobs for every 100 L processed, depending on the level of technified operation and productive organization. However, in order to this potential be translated into tangible benefits, it is essential to consolidate a structured action plan that allows us to move towards a more efficient, competitive and sustainable production model.

The model articulates four strategic components: inputs, activities, outputs, and results, aimed at generating a final impact on the economic and social well-being of the producing communities. In the Inputs component, the need to guarantee the quality of the raw material is raised through the preparation of budgets for the acquisition of balanced feed,

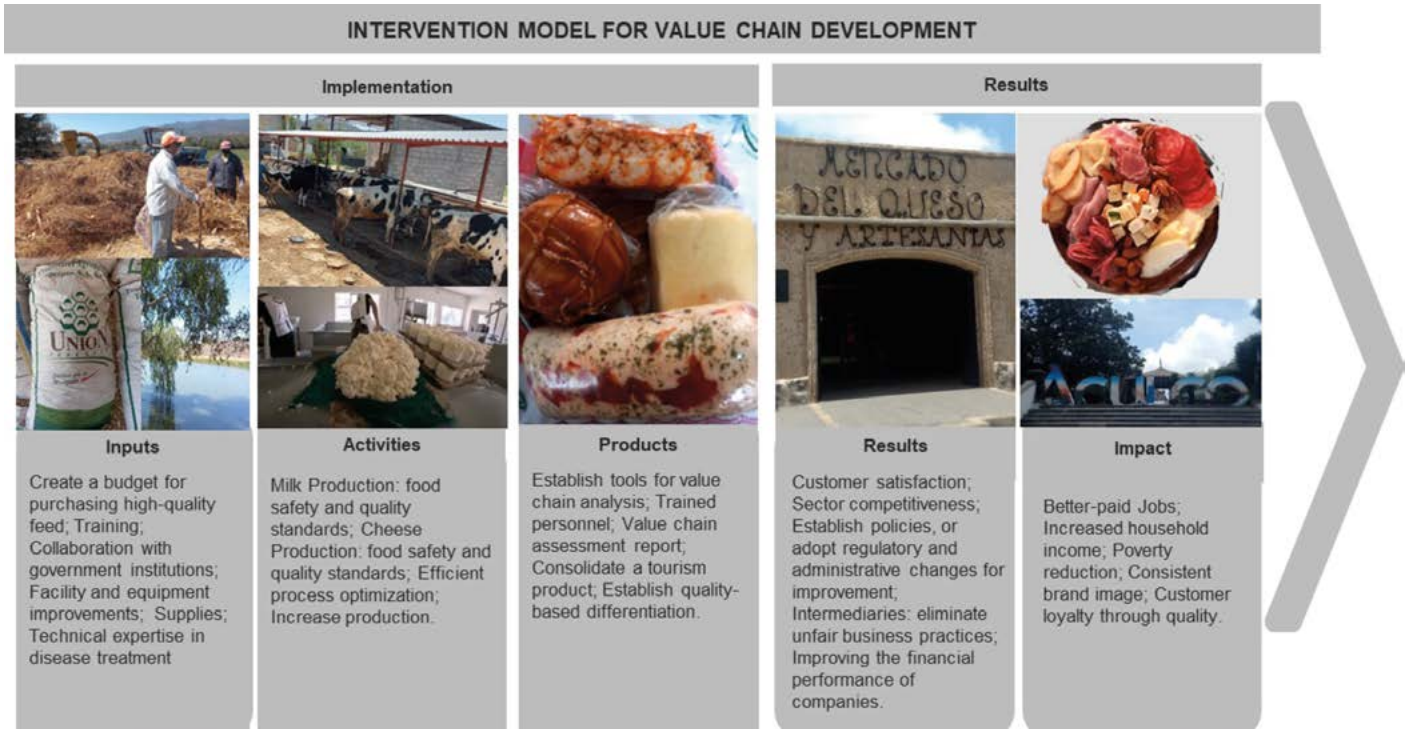

Figure 2. Intervention model for the value chain of cheese production in Aculco (State of Mexico) Mexico. Photographs: Vianney González-Hernández.

technical training, collaboration with support institutions, and the improvement of facilities and equipment. Likewise, the importance of adequate supplies, and technical expertise in animal health and disease management is emphasized. Since these are elements that contribute to increasing productivity and ensuring the safety of the final product.

The Activities component focuses on applied research and milk production under quality standards, as well as on the production of cheeses differentiated by flavor and texture. This section seeks to optimize production and management processes, promoting a more efficient use of resources and greater coordination between the agents of the chain. The technified operation of processes, accompanied by the continuous training of human resources, is conceived as a central axis to increase the competitiveness of the system.

In the Products component, the model proposes the establishment of analysis tools for the monitoring of the value chain, the strengthening of work force training, and the consolidation of products with greater added value. Differentiation by quality is considered a key element to position local production in regional and national markets. As well as to reinforce a collective image that associates Aculco cheese with high standards of authenticity and quality.

Finally, the Results component translates into tangible improvements in customer satisfaction, the competitiveness of the sector, and the financial performance of small agribusinesses. We considered here the reduction of unfair intermediation practices, the implementation of support policies, and the promotion of regulatory changes favorable to local producers. These results constitute the basis for generating a positive impact on

the rural economy, which would be reflected in better-paid jobs, increased family income, poverty reduction, and strengthening of territorial identity. This improvement would be based on product quality and customer loyalty.

Overall, the proposed intervention model represents a systemic strategy that integrates the technical, economic and social aspects of the cheese value chain in Aculco. The implementation would allow progressing towards a sustainable territorial development model, based on cooperation among producers, institutions, and commercial agents, where quality, innovation and collective organization can be consolidated as the main drivers of competitiveness and resilience of the local agrifood sector.

CONCLUSIONS

The analysis of the cheese value chain in Aculco (State of Mexico) Mexico made it evident that, despite economic, cultural and territorial importance, the production system operates under conditions of organizational fragmentation, low technified operation, and limited coordination among social actors. These characteristics restrict the generation of added value, competitiveness, and sustainability of the local agrifood system.

The strengthening of the organizational, technical and management capacities of small producers, together with the promotion of mechanisms of articulation and territorial cooperation, is essential to move towards a more efficient and resilient production model. In this sense, the value chain approach is consolidated as a strategic tool to guide comprehensive interventions that contribute to the sustainable territorial development of the dairy cheese sector in the municipality of Aculco.

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REFERENCES

CANILEC. (2024). Compendio de estadísticas del sector lácteo 2013-2023. https://www.canilec.org.mx/wp-content/uploads/2024/05/CompendioESTADISTICAS_CANILEC2024_compressed.pdf

CEPAL. (2014). La agroindustria y el desarrollo inclusivo: el caso de la cadena láctea en América Latina. Santiago de Chile: Naciones Unidas. https://repositorio.cepal.org/bitstream/handle/11362/36729/1/S2014184_es.pdf

Cravero, R. A., & Montagna, J. M. (2020). Caracterización de las pérdidas físicas en la cadena de valor láctea Argentina: Oportunidades y desafíos. AJEA (Actas de Jornadas y Eventos Académicos de UTN), (5). https://doi.org/10.33414/ajea.5.660.2020

Crespo, J., Réquier-Desjardins, D., & Vicente, J. (2014). Why can collective action fail in local agri-food systems? A social network analysis of cheese producers in Aculco, Mexico. *Food Policy*, 46, 165-177. https://doi.org/10.1016/j.foodpol.2014.03.011

De Groot, O. J. (2018). La cadena regional de valor de la industria de lácteos en Centroamérica (LC/MEX/TS.2018/2). Comisión Económica para América Latina y el Caribe (CEPAL), Naciones Unidas. https://repositorio.cepal.org/server/api/core/bitstreams/d94fa06d-7d41-4627-9e3e-84049a1fe722/content

Durán-Rojas, E., Pérez Espitia, P. J., & Pérez-Sierra, O. A. (2020). Milk producer's articulation: A multicast study in Córdoba, Colombia. *Revista Logos, Ciencia & Tecnología, 12*(1), 110-120. https://doi.org/10.22335/rlct.v12i1.1020

FAO. (2024). El desarrollo del sector lechero. FAO Portal lácteo. https://www.fao.org/dairy-production-products/socio-economics/dairy-development/es

García-Villegas, J. de D., Arriaga-Jordán, C. M., García-Martínez, A., Rayas-Amor, A. A., & Martínez-García, C. G. (2021). Factores que influyen en el uso de tecnologías de información y comunicación (TIC) por productores de leche en pequeña escala. *Tropical and Subtropical Agroecosystems, 24*(1). https://doi.org/10.56369/tsaes.3338

Hidalgo-Milpa, M., Arriaga-Jordán, C. M., Cesín-Vargas, A., & Espinoza-Ortega, A. (2016). Characterisation of consumers of traditional foods: The case of Mexican fresh cheeses. *British Food Journal, 118*(4), 915–930. https://doi.org/10.1108/BFJ-02-2015-0083

INEGI. (2024). Matriz insumo-producto. https://www.inegi.org.mx/temas/mip/

Macías, J. D. (2019). Producción y consumo agroalimentario en áreas perimetropolitanas: Una aproximación tipológica desde el enfoque de proximidad. *Estudios Sociales. Revista de Alimentación Contemporánea y Desarrollo Regional, 29*(53). https://doi.org/10.24836/es.v29i53.701

Nutz, N., & Sievers, M. (2016). Guía general para el desarrollo de cadenas de valor: Cómo crear empleo y mejores condiciones de trabajo en sectores objetivos. Organización Internacional del Trabajo (OIT). https://bluebooksoft.com/GESTION_ADMINISTRATIVA/2209.pdf

Oddone, N., & Padilla Pérez, R. (eds.) (2017). Fortalecimiento de cadenas de valor rurales (LC/TS.2017/24). Comisión Económica para América Latina y el Caribe (CEPAL) / Fondo Internacional de Desarrollo Agrícola (FIDA). https://repositorio.cepal.org/server/api/core/bitstreams/4e0d7cc5-5ccb-4f57-9342-60e0e17a1b66/content

Porter, M. E. (1985). Competitive advantage: Creating and sustaining superior performance. New York, NY: Free Press. https://imarcai.com/wp-content/uploads/2019/04/Porter-1985-chapter-1.pdf?utm_source

SECAMPO. (2024). La cuenca lechera de Aculco-Polotitlán-Jilotepec: producción y consumo de productos lácteos en el Estado de México. Gobierno del Estado de México. https://secampo.edomex.gob.mx/node/593

Vilchis-Granados, G. B., Morales-Morales, E. J., Herrera-Haro, J. G., Gómez-Demetrio W., Martínez-Castañeda, F. E., & Martínez-Campos, A. R. (2024). Production Analysis of Corn (*Zea mays* L.) in Agricultural District VII Valle de Bravo, State of Mexico. *Agro Productividad*. https://doi.org/10.32854/agrop.v17i11.2909