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**SCIENTIFIC DEVELOPMENT IN THE COATZACOALCOS-MINATITLÁN
CORRIDOR (2000-2025): A MULTIDISCIPLINARY PERSPECTIVE**

*DESARROLLO CIENTÍFICO EN EL CORREDOR COATZACOALCOS-MINATITLÁN
(2000-2025): UNA VISIÓN MULTIDISCIPLINARIA*

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Desarrollo Científico en el Corredor Coatzacoalcos-Minatitlán (2000-2025): Una Visión Multidisciplinaria

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RESUMEN

Este estudio caracteriza el desarrollo científico relacionado con el corredor Coatzacoalcos-Minatitlán, Veracruz, México, durante el periodo 2000-2025. Su objetivo fue identificar las tendencias de publicación, la evolución temática, la visibilidad medida mediante citas, la distribución institucional y los patrones de colaboración de la producción científica regional. Se realizó un análisis bibliométrico basado en una búsqueda estructurada en Google Scholar, con acceso documental mediante la Biblioteca Digital de la Universidad Nacional Autónoma de México. Las publicaciones se clasificaron según el tipo de documento, el año, el área de investigación, el número de citas, la afiliación institucional y las relaciones de colaboración. El corpus quedó integrado por 442 publicaciones: 378 artículos de revista, 36 ponencias en congresos y 28 capítulos de libro, que acumularon 5.572 citas hasta el 31 de diciembre de 2025. La producción aumentó durante el periodo analizado, especialmente a partir de 2015, y comprendió cuatro áreas: ciencias e ingeniería; ciencias económicas, administrativas y sociales; educación; y salud. La producción con afiliación local se concentró en la Universidad Veracruzana, el Tecnológico Nacional de México y el Instituto Mexicano del Seguro Social, mientras que PEMEX participó principalmente en redes de colaboración. Los resultados ofrecen una referencia regional para la planificación científica y la cooperación interinstitucional

Palabras clave: análisis bibliométrico; colaboración institucional; corredor Coatzacoalcos-Minatitlán; desarrollo regional; producción científica

Scientific Development in the Coatzacoalcos-Minatitlán Corridor (2000-2025): A Multidisciplinary Perspective

ABSTRACT

This study characterizes scientific development related to the Coatzacoalcos-Minatitlán corridor in Veracruz, Mexico, from 2000 to 2025. It aimed to identify publication trends, thematic evolution, citation-based visibility, institutional distribution, and collaboration patterns in regional scientific production. A bibliometric analysis was conducted through a structured search in Google Scholar, with document access provided by the Digital Library of the National Autonomous University of Mexico. Publications were classified by document type, year, research area, citation count, institutional affiliation, and collaboration relationships. The corpus comprised 442 publications: 378 journal articles, 36 conference papers, and 28 book chapters, which had accumulated 5,572 citations as of December 31, 2025. Scientific production increased during the period analyzed, particularly after 2015, and encompassed four areas: sciences and engineering; economic, administrative, and social sciences; education; and health. Locally affiliated production was concentrated in the Universidad Veracruzana, the Tecnológico Nacional de México, and the Mexican Institute of Social Security, while PEMEX participated mainly in collaboration networks. The results provide a regional baseline for scientific planning and interinstitutional cooperation

Keywords: bibliometric analysis; Coatzacoalcos-Minatitlán corridor; institutional collaboration; regional development; scientific production

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INTRODUCTION

Located on the Isthmus of Tehuantepec in southeastern Mexico, the Coatzacoalcos-Minatitlán corridor (C-Mc) is an industrial, port, and urban region of strategic importance (Figure 1). Its environmental setting includes a hot and humid climate, intense seasonal rainfall, coastal and riverine ecosystems, and an extensive hydrographic network connected to the lower Coatzacoalcos River basin (Revuelta-Acosta et al., 2022; National Institute of Statistics, Geography, and Informatics [INEGI], 1990). The coastal sediments of Coatzacoalcos are predominantly sandy and contain quartz, feldspar, and lithic fragments, whereas Minatitlán is mainly associated with Acrisol soils (Armstrong-Altrín et al., 2021). These environmental characteristics have influenced settlement patterns, industrial development, water availability, and the research problems addressed in the region.

The corridor's strategic importance emerged with the construction of the Trans-Isthmus Railroad and was consolidated during the twentieth-century oil boom, which stimulated the growth of Coatzacoalcos and Minatitlán and strengthened their commercial and industrial integration (Cabañas et al., 2022; Torres-Fragoso, 2022). The Lázaro Cárdenas del Río refinery in Minatitlán and the port infrastructure of Coatzacoalcos reinforced the regional circulation of petroleum and petrochemical products (Martínez-Laguna et al., 2002). These processes also transformed social structures, migration patterns, identities, and urban space (De la Cruz et al., 2018). The longstanding objective of connecting the Gulf of Mexico with the Pacific Ocean across the Isthmus of Tehuantepec continues to shape infrastructure and trade projects in the region (Budar et al., 2017; Hofmann, 2024; Lotfe-Calderón et al., 2011).

In recent decades, public policy and private investment have reinforced the corridor's role in national and international trade. The designation of the Isthmus of Tehuantepec as a strategic development area, together with its connection to the ports of Coatzacoalcos and Salina Cruz, has strengthened its potential as an interoceanic logistics route (Gómez-Zaldívar & Molina, 2018). Its geographic position and links with southeastern Mexico have favored industrial concentration, employment, and regional market integration (Casado-Izquierdo & Sánchez-Salazar, 2013). Approximately 65 industrial facilities

have operated in the C-Mc, while commercial activity has contributed to changes in the urban landscape and the regional distribution of goods (Ortega, 2019; Ruiz-Fernández et al., 2012).

Industrial and urban expansion has also intensified environmental and social pressures. The lower Coatzacoalcos River basin has been identified as one of Mexico's most polluted areas, with consequences for ecosystems, public health, and quality of life (Santiago et al., 2024). Dependence on petroleum-related activities, inequality, insecurity, health risks, migration, and accelerated urban growth have increased the complexity of regional development (Cabañas et al., 2022; Cuevas-Díaz et al., 2020). These conditions have generated research problems that require environmental, technological, economic, social, educational, and health perspectives.

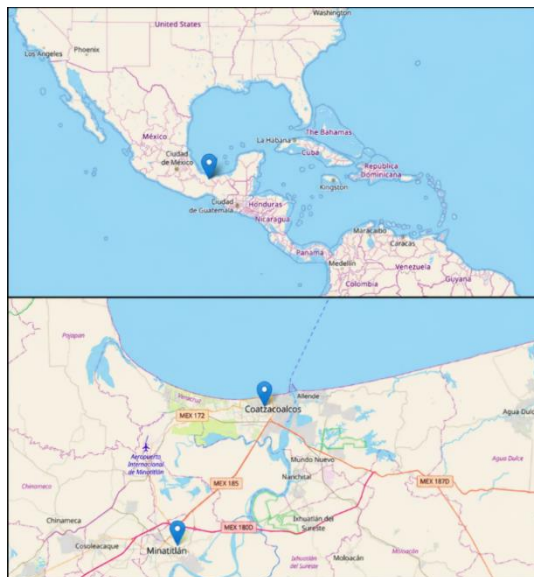
Scientific research contributes to knowledge generation, innovation, the analysis of regional problems, and social well-being (Colina, 2007). Scientific literacy also supports informed decision-making and the capacity to respond to complex challenges (Norambuena-Meléndez et al., 2023). Within the C-Mc, universities, research centers, health institutions, public agencies, and industrial organizations have produced studies on environmental pollution, engineering, energy, health, education, administration, employment, and social development. Regional engineering research has also examined technological and industrial processes, including thermal systems and heat-exchange configurations (Ramírez-Dolores et al., 2024).

This scientific production remains dispersed across journals, conference proceedings, and book chapters, limiting an integrated understanding of its evolution, thematic composition, visibility, and institutional structure. Bibliometric analysis can identify publication trends, thematic concentrations, citation patterns, institutional participation, and collaboration networks, thereby providing evidence for research planning and cooperation among universities, government agencies, and industry (Hertrich & Brenner, 2024; Kogler et al., 2024; Meyborg & Schaffer, 2014).

Accordingly, this study characterizes scientific production related to the C-Mc from 2000 to 2025. It examines temporal trends, recurring themes, citation-based visibility, institutional and geographic distribution, and collaboration networks. The analysis seeks to establish a regional baseline that may

support research planning, scientific policy, interdisciplinary cooperation, and the identification of thematic and institutional areas requiring further development.

Figure 1. Location of the Coatzacoalcos-Minatitlán corridor.



Source: Authors' own work.

MATERIALS AND METHODS

Study design and information source

A retrospective, descriptive bibliometric study was conducted to characterize scientific production related to the Coatzacoalcos-Minatitlán corridor. The multidisciplinary corpus included publications from four broad fields: sciences and engineering; economic, administrative, and social sciences; education; and health.

Google Scholar was used as the information source because of its broad disciplinary coverage and its capacity to retrieve journal articles and other academic documents that may not be represented in selective bibliographic databases (Gusenbauer & Haddaway, 2020). Access to full-text documents was supported by the Digital Library of the National Autonomous University of Mexico (UNAM), journal websites, conference repositories, and book repositories. Given the characteristics of Google Scholar, the procedure was treated as a structured documentary search rather than an exhaustive systematic review.

Search strategy and eligibility criteria

The search covered publications issued between January 1, 2000, and December 31, 2025. The terms “Coatzacoalcos” and “Minatitlán” were used to identify potentially relevant records. A publication was included when at least one of these terms appeared in its title, abstract, keywords, introduction, or methods section and its content was directly related to the geographic area under study.

The analysis comprised journal articles, conference papers, and book chapters. Documents that met the eligibility criteria were reviewed in full and incorporated into the database. The resulting corpus consisted of 442 publications.

For each publication, the database recorded the year, document type, research field, title, complete bibliographic reference, citation count, author affiliations, keywords, Journal Citation Reports (JCR) indexing status, and journal impact factor when available. Citation counts corresponded to the values recorded at the cutoff date of December 31, 2025. JCR indexing and impact-factor data were used descriptively to characterize the publication channels and were not treated as direct measures of scientific quality.

Bibliometric classification

Scientific production was analyzed across six dimensions:

Temporal trends: annual number and type of publications issued between 2000 and 2025.

Recurring themes: identification and grouping of the principal topics addressed.

Citation-based visibility: citation counts and identification of the ten most cited publications, including the journal and its impact factor when applicable.

Thematic distribution: classification into sciences and engineering; economic, administrative, and social sciences; education; and health.

Geographic and institutional distribution: identification of publications involving authors affiliated with institutions located within or outside the corridor.

Institutional collaboration: identification of relationships among universities, research centers, health institutions, public agencies, and private organizations.

Each publication was assigned to the area that best represented its predominant subject, based on the title, abstract, keywords, objectives, and disciplinary orientation of the study. Publications addressing related subjects were grouped into recurring thematic categories. This organization supported a joint interpretation of temporal patterns, institutional associations, and lines of research within the regional scientific landscape, consistent with the complementarity approach described by Bertel-Narváez et al. (2019).

Institutional and collaboration analysis

Author affiliations were used to distinguish publications involving institutions located within the C-Mc from those produced exclusively by researchers based outside the corridor. Academic or organizational units belonging to the same campus or institution were grouped under a common code. The complete names of the institutions, campuses, and units included in each code are provided in Supplementary Table S1.

Institutional collaboration was identified through the co-occurrence of affiliations in the same publication. The diagrams included institutions with more than one collaborative relationship and represented the existence of links among academic, technological, industrial, health, educational, and governmental organizations. Repeated collaborations were not used to calculate link strength, network density, centrality, or other structural indicators. The networks were therefore interpreted as descriptive representations of the institutional relationships found in the corpus.

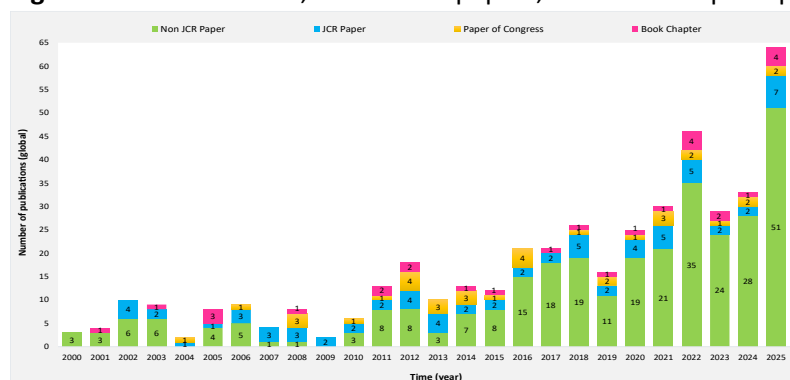
RESULTS AND DISCUSSION

A total of 442 publications related to the C-Mc were identified for the 2000-2025 period. These comprised 378 journal articles (85.5%), 36 conference papers (8.1%), and 28 book chapters (6.3%). The percentages do not total 100% because of rounding. Among the journal articles, 71 were published in journals indexed in the Journal Citation Reports (JCR). The results were analyzed according to temporal trends, recurring research themes, citation-based visibility, institutional distribution, and collaboration patterns.

Time trends

Figure 2 shows an overall, although irregular, increase in scientific production between 2000 and 2025. Based on the criterion of at least two consecutive years of growth relative to the preceding year, six periods of increased activity were identified.

Figure 2. Journal articles, conference papers, and book chapters published between 2000 and 2025.



Source: Authors' own work based on the analyzed corpus.

The first two periods, 2000-2002 and 2004-2006, comprised 17 and 19 publications, respectively. The first included one book chapter, 12 non-JCR journal articles, and four articles published in JCR-indexed journals. The second consisted of three book chapters, two conference papers, nine non-JCR journal articles, and five JCR-indexed articles. During both periods, most JCR-indexed publications involved researchers affiliated with institutions outside the corridor, indicating limited local participation in these publication channels.

The 2009-2012 period comprised 39 publications: four book chapters, six conference papers, 19 non-JCR journal articles, and 10 JCR-indexed articles. Only one of the JCR-indexed articles involved a researcher affiliated with a local institution, specifically the Faculty of Chemical Sciences of the Universidad Veracruzana in Coatzacoalcos. Research during this period focused mainly on toxicology, microbiology, chemistry, environmental pollution, and population studies.

Scientific output expanded after 2015. Between 2015 and 2018, 80 publications were recorded, including three book chapters, six conference papers, 60 non-JCR journal articles, and 11 JCR-indexed articles.

Three of the latter involved locally affiliated researchers. The 2019-2022 period comprised 117 publications: seven book chapters, eight conference papers, 86 non-JCR journal articles, and 16 JCR-indexed articles, four of which included local affiliations.

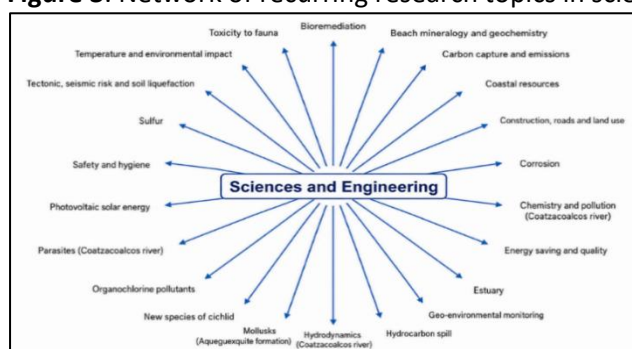
The highest output occurred during 2023-2025, with 126 publications: seven book chapters, five conference papers, 103 non-JCR journal articles, and 11 JCR-indexed articles. Although this period recorded the largest publication volume, it contained fewer JCR-indexed articles than 2019-2022. The difference indicates that the documented production grew more rapidly in volume than in its presence within JCR-indexed journals.

The temporal pattern reflects a transition from an initial stage characterized mainly by research conducted by externally affiliated authors toward broader participation by local institutions. Even so, locally affiliated publications remained comparatively underrepresented in JCR-indexed journals. The increase in overall production, therefore, was not accompanied by proportional growth in this particular form of international scholarly visibility.

Recurring themes

The analyzed corpus displayed broad thematic diversity and was organized into four areas: sciences and engineering; economic, administrative, and social sciences; education; and health. The recurring topics within each area illustrate the multidisciplinary character of research related to the C-Mc.

Figure 3. Network of recurring research topics in sciences and engineering.

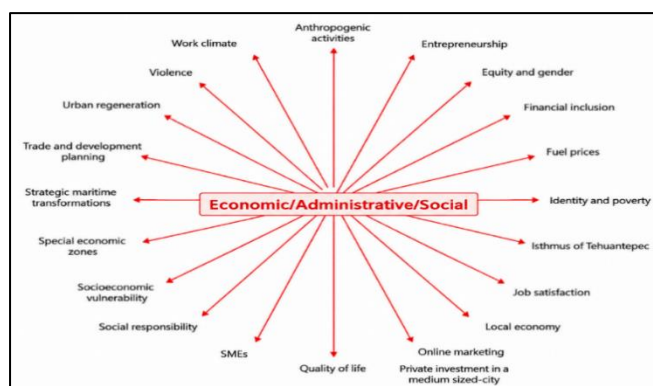


Source: Authors' own work based on the analyzed corpus.

Sciences and engineering comprised 22 recurring topics. Several were closely related, particularly pollution in the Coatzacoalcos River, persistent organochlorine pollutants, and the chemical

characteristics of the river system. These connections reflect the importance of environmental and industrial problems within scientific research concerning the corridor.

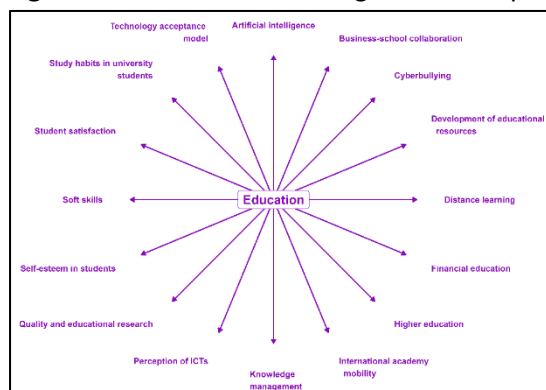
Figure 4. Network of recurring research topics in economic, administrative, and social sciences.



Source: Authors' own work based on the analyzed corpus.

The economic, administrative, and social sciences included 21 recurring topics. Relationships were observed between the local economy and entrepreneurship, as well as among the work environment, job satisfaction, and small and medium-sized enterprises. Within the corpus analyzed, no publications assigned to this area appeared in journals indexed in the JCR. This finding describes the publication channels represented in the corpus and does not indicate the quality or relevance of the research.

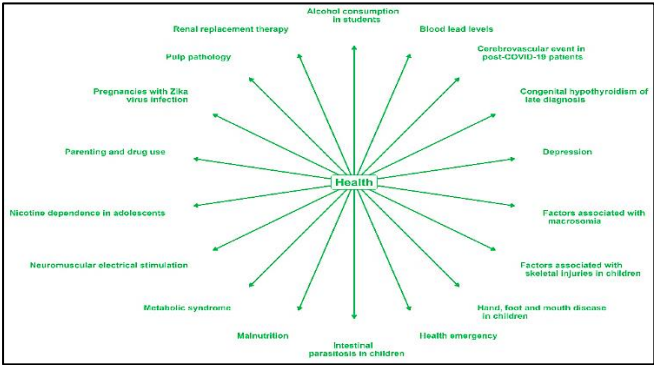
Figure 5. Network of recurring research topics in education.



Source: Authors' own work based on the analyzed corpus.

Education comprised 16 recurring topics. Relationships appeared between student self-esteem and satisfaction, and between the development of educational resources and artificial intelligence. Most publications in this area were issued between 2016 and 2025. As in the preceding area, none of the educational publications retrieved for the corpus appeared in JCR-indexed journals.

Figure 6. Network of recurring research topics in health.



Source: Authors’ own work based on the analyzed corpus.

Health comprised 18 recurring topics. Several connections involved alcohol consumption, nicotine dependence among students, and depression. Other related subjects included pregnancies involving Zika virus infection and responses to health emergencies. Together, these themes show that health research in the corridor has addressed behavioral, epidemiological, reproductive, and institutional concerns.

Impact of publications

The 442 publications accumulated 5,572 citations as of December 31, 2025. Table 1 presents the ten most cited publications, the journals in which they appeared, and the impact-factor values recorded during data collection.

Table 1

	Reference	Citation	Journal	Impact factor
1	Martínez-Herrera et al. (2006)	756	Food Chemistry	10.4
2	Barrera-Roldán & Saldivar-Valdés (2002)	263	Ecological Indicators	8.7
3	Corvo et al. (2008)	215	Corrosion Science	10.3
4	Armstrong-Altrin (2015)	190	International Geology Review	1.9
5	Li et al. (2004)	176	Journal of Medical Entomology	2.1
6	Li et al. (2003)	170	Journal of Medical Entomology	2.1
7	Saavedra-Rodríguez et al. (2018)	121	Scientific Reports	4.9

8	Jonsson et al. (2007)	113	Veterinary Parasitology	2.7
9	Hernandez et al. (2002)	101	Insect Biochemistry and Molecular Biology	4.3
10	Flores et al. (2013)	96	Journal of Economic Entomology	2.5

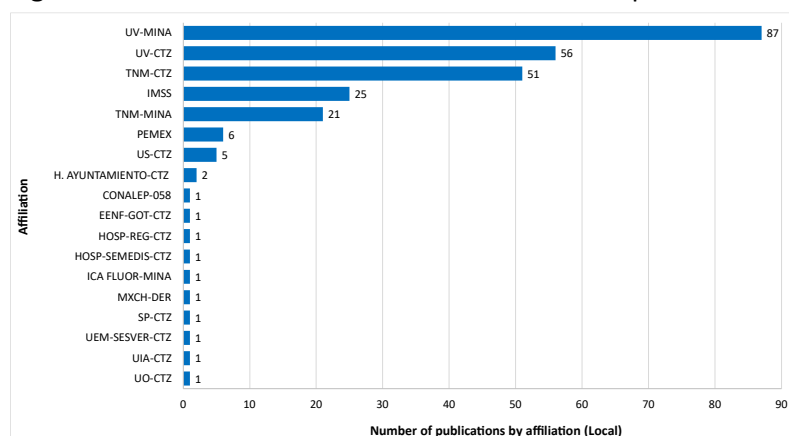
Note. Citation counts correspond to the values recorded as of December 31, 2025. Because citation totals and journal impact factors change over time, the values are used only as descriptive indicators of scholarly visibility. Impact factors correspond to those recorded during data collection and are not interpreted as direct measures of research quality. Source: Authors' own work based on the analyzed corpus.

Martínez-Herrera et al. (2006) was the most cited publication, with 756 citations, followed by Barrera-Roldán and Saldivar-Valdés (2002), with 263, and Corvo et al. (2008), with 215. Together, the ten publications accumulated 2,201 citations, representing 39.5% of the total. Citation-based visibility was therefore concentrated in a small group of studies published mainly in internationally indexed journals within scientific and environmental fields. This concentration indicates an uneven distribution of citations across the corpus, but it does not establish differences in the quality or regional relevance of the publications.

Institutional distribution of local scientific production

A total of 263 publications involved at least one author affiliated with a public or private institution located in the C-Mc. Academic and organizational units belonging to the same campus or institution were grouped under a common code. Institutional codes were created from the abbreviated name of each institution, campus, or academic unit and are defined when first mentioned in the results.

Figure 7. Affiliations of local authors and number of publications.



Source: Authors' own work based on the analyzed corpus.

UV-MINA had the largest number of publications involving local affiliations, with 87, followed by UV-CTZ with 56, TNM-CTZ with 51, IMSS with 25, and TNM-MINA with 21. These five institutions were associated with 240 of the 263 locally affiliated publications, representing 91.3% of the total.

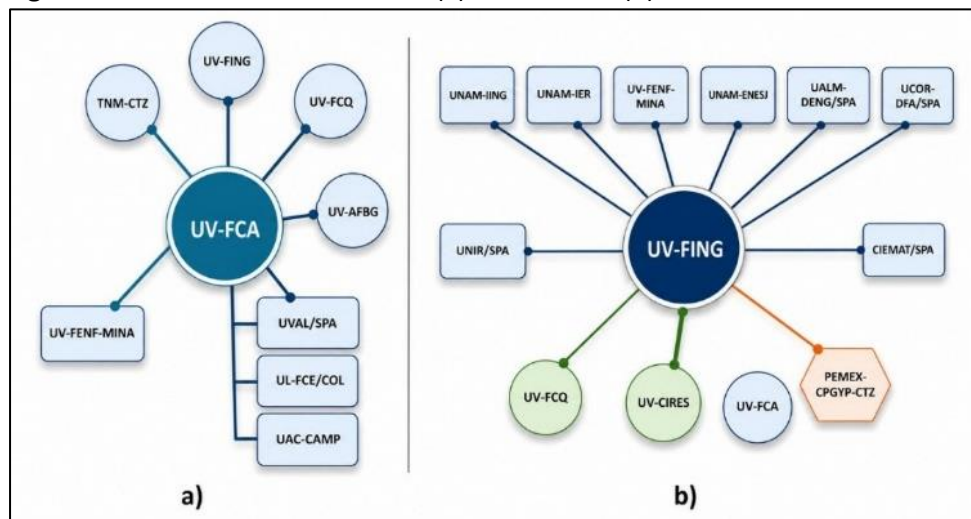
At UV-MINA, the Faculty of Nursing contributed mainly to research on health, addiction prevention, and human behavior. At UV-CTZ, the Faculties of Engineering and Chemical Sciences had a notable presence in JCR-indexed publications. Research associated with TNM-CTZ focused primarily on educational technology, student competencies, engineering, and social issues. The remaining locally affiliated production included PEMEX with six publications, Universidad de Sotavento with five, and the Municipal Government of Coatzacoalcos with two. Other institutions participated in one publication each.

Institutional collaboration and networks

The collaboration networks were constructed from the co-occurrence of institutional affiliations in publications involving at least one organization located in the C-Mc. Only institutions with more than one collaborative relationship were included. They were classified as academic, technological, industrial, health, educational, or governmental organizations.

The Faculty of Accounting and Administration of the Universidad Veracruzana in Coatzacoalcos (UV-FCA) collaborated with TNM-CTZ, other academic units of the Universidad Veracruzana, the Universidad Autónoma del Carmen, the University of Valencia, and the University of Los Llanos. The Faculty of Engineering in Coatzacoalcos (UV-FING) was linked with UV-CIRES, UV-FCA, UV-FCQ, UV-FENF-MINA, several units of the National Autonomous University of Mexico, institutions in Spain, and PEMEX (Figure 8).

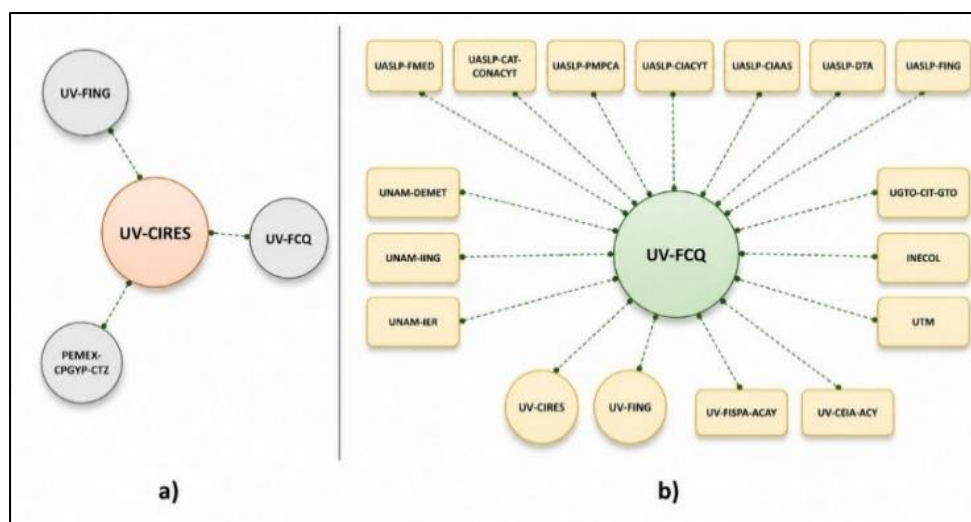
Figure 8. Collaboration networks of (a) UV-FCA and (b) UV-FING in Coatzacoalcos.



Note. Source: Authors' own work based on the analyzed corpus.

The Center for Research in Sustainable Energy Resources (UV-CIRES) collaborated with UV-FING, UV-FCQ, and PEMEX. The Faculty of Chemical Sciences in Coatzacoalcos (UV-FCQ) was connected with regional academic units, institutions of the Universidad Autónoma de San Luis Potosí, several UNAM institutes, the Universidad de Guanajuato, and other Mexican research organizations (Figure 9).

Figure 9. Collaboration networks of (a) UV-CIRES and (b) UV-FCQ in Coatzacoalcos.

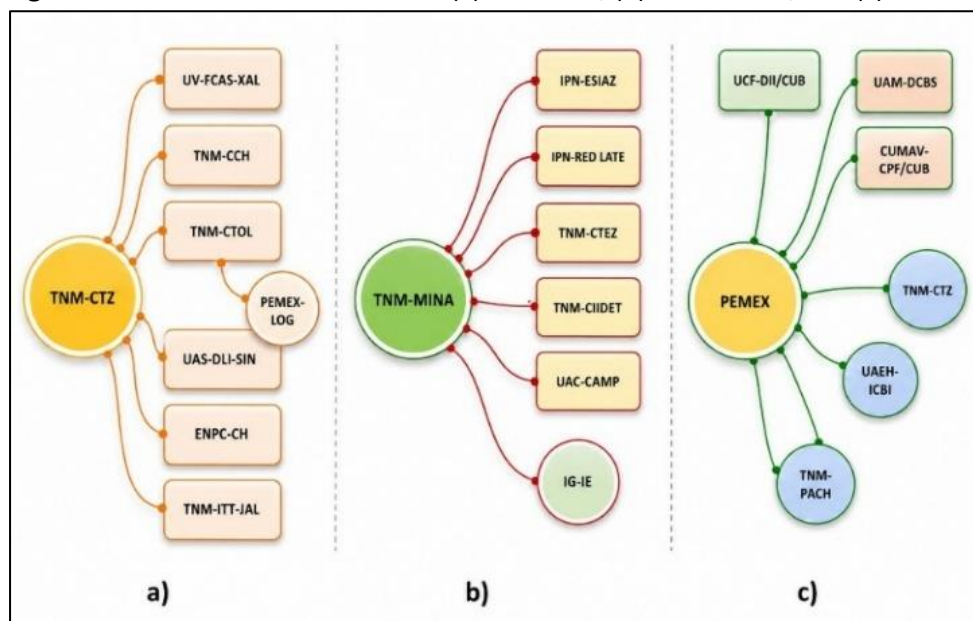


Note. Source: Authors' own work based on the analyzed corpus.

The Tecnológico Nacional de México campuses collaborated primarily with institutions located in Mexico. TNM-CTZ was linked with academic and technological organizations from several states, whereas TNM-MINA collaborated with other TNM campuses, the Universidad Autónoma del Carmen,

and a local institution dedicated to educational innovation. PEMEX participated in publications with TNM, the Universidad Autónoma del Estado de Hidalgo, and Cuban universities (Figure 10).

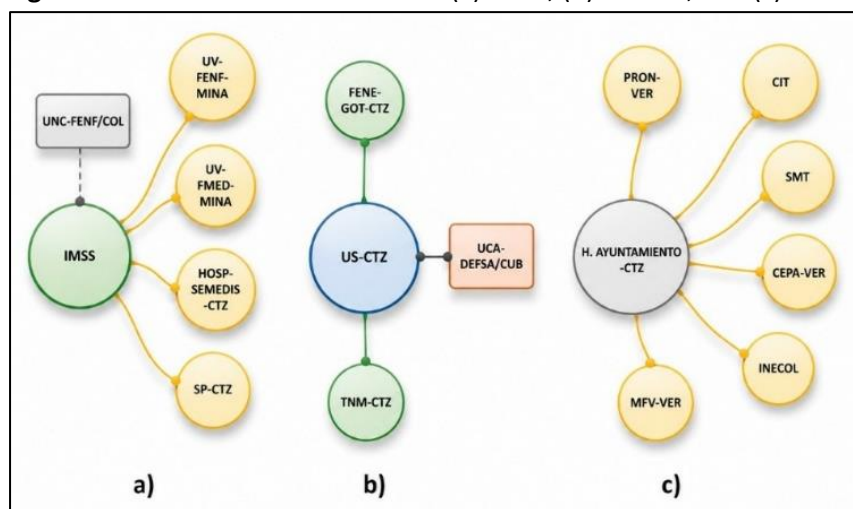
Figure 10. Collaboration networks of (a) TNM-CTZ, (b) TNM-MINA, and (c) PEMEX.



Note. Source: Authors' own work based on the analyzed corpus.

The Mexican Institute of Social Security (IMSS) collaborated with faculties of the Universidad Veracruzana, private hospitals in Coatzacoalcas, and the Universidad Nacional de Colombia. The Universidad de Sotavento was linked with TNM-CTZ, the Gotinga School of Nursing, and the Universidad de Ciego de Ávila. The Municipal Government of Coatzacoalcas participated in publications with environmental, research, professional, and consulting organizations (Figure 11).

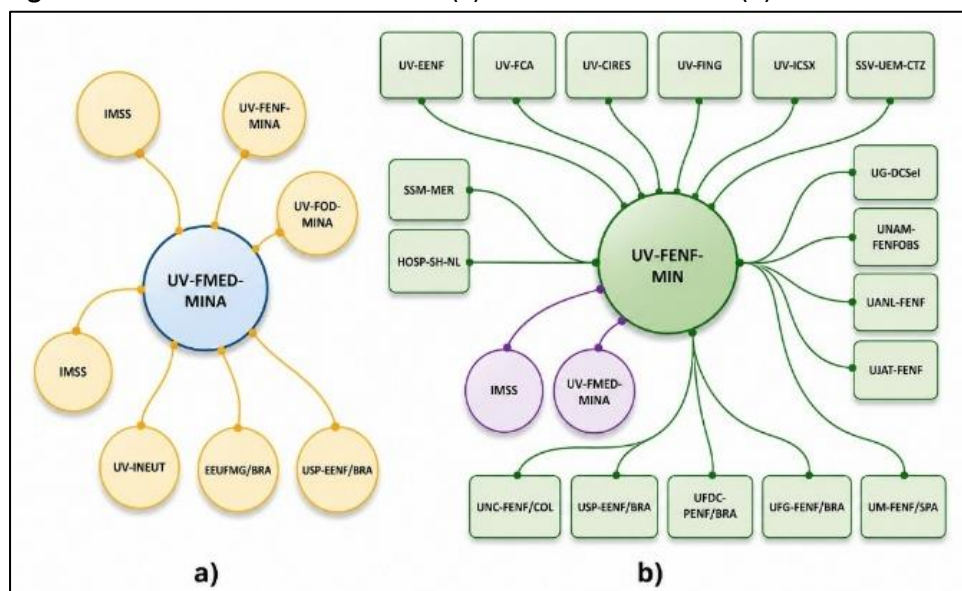
Figure 11. Collaboration networks of (a) IMSS, (b) US-CTZ, and (c) H. AYUNTAMIENTO-CTZ.



Note. Source: Authors' own work based on the analyzed corpus.

The Faculty of Medicine at UV-MINA (UV-FMED-MINA) collaborated with the IMSS, the Faculties of Nursing and Dentistry, the Institute of Neuroethology of the Universidad Veracruzana, and institutions in Brazil. The Faculty of Nursing at UV-MINA (UV-FENF-MINA) participated in publications with academic and health institutions in Mexico, Colombia, Brazil, and Spain (Figure 12).

Figure 12. Collaboration networks of (a) UV-FMED-MINA and (b) UV-FENF-MINA.



Note. Source: Authors' own work based on the analyzed corpus.

The collaboration diagrams describe institutional relationships at local, national, and international levels. Because collaboration frequency, link strength, network density, and centrality were not calculated, these figures should be interpreted as descriptive maps rather than quantitative network analyses. They identify the participating institutions and the existence of connections within the corpus but do not establish the intensity, stability, or relative importance of those relationships.

The temporal results show that scientific production related to the C-Mc became more frequent during the latter part of the period analyzed, particularly after 2015. This increase documents growth in publication volume but should not be interpreted as direct evidence of improved research quality, stronger institutional capacity, or greater international impact, as these dimensions were not evaluated. The findings therefore support a descriptive conclusion about the expansion of the documented scientific output.

Publications in JCR-indexed journals followed a different trajectory. Although total production increased, the number of JCR-indexed articles remained comparatively limited and varied across the periods examined. Most of the growth consequently occurred through publication channels outside the JCR. Inclusion in this index represents a characteristic of the journal and may contribute to international visibility, but it is not a direct or exclusive measure of the quality, relevance, or social contribution of an individual publication.

The thematic distribution reflects the multidimensional character of the C-Mc. The prominence of sciences and engineering is consistent with the industrial, petrochemical, and environmental conditions of the region. Previous studies have documented environmental vulnerability, industrial pressures, and pollution in the lower Coatzacoalcos River basin (Cabañas et al., 2022; Santiago et al., 2024), as well as the effects of urban and industrial expansion on the regional environment and population (Cuevas-Díaz et al., 2020). The presence of research on pollution, chemistry, corrosion, energy, geosciences, and industrial processes corresponds with these previously recognized regional problems.

Scientific interest in the corridor was not restricted to its industrial and environmental characteristics. The corpus also included research in economic, administrative, and social sciences, education, and health. Topics related to employment, entrepreneurship, inequality, educational processes, student behavior, addictions, reproductive health, and nursing indicate that the regional research agenda has also addressed social and human concerns.

Differences were observed in the publication channels used by the four thematic areas. Sciences and engineering had the greatest presence in JCR-indexed journals, whereas none of the publications classified under education or economic, administrative, and social sciences appeared in that index. This finding applies exclusively to the corpus analyzed and does not demonstrate that research in these fields is less rigorous or relevant. Differences in disciplinary coverage and publication practices were not examined and therefore cannot be used to explain the observed distribution.

Citation-based visibility was concentrated in a limited group of publications, although citation counts do not necessarily represent scientific quality or regional relevance. Overall, the C-Mc scientific landscape was characterized by increasing and multidisciplinary production, concentration in a small number of institutions, unequal representation of thematic areas in JCR-indexed journals, and collaboration at local, national, and international levels.

These findings provide an initial descriptive overview of regional scientific production. Because Google Scholar differs from selective bibliographic databases in its coverage, indexing, and retrieval procedures, the corpus should not be regarded as exhaustive (Gusenbauer & Haddaway, 2020). Future studies incorporating additional databases and quantitative network indicators could extend this regional characterization and provide a more detailed assessment of collaboration structures and scientific visibility.

CONCLUSIONS

This study provides an integrated bibliometric characterization of scientific production related to the Coatzacoalcos-Minatitlán corridor between 2000 and 2025. The corpus comprised 442 publications and showed an overall increase in output, particularly after 2015. The studies covered four broad areas: sciences and engineering; economic, administrative, and social sciences; education; and health. This thematic distribution confirms the multidisciplinary character of research concerning the corridor.

Representation in JCR-indexed journals was uneven across fields and concentrated mainly in sciences and engineering. Of the 378 journal articles identified, 71 appeared in journals included in the JCR. Citation-based visibility was also concentrated: the ten most cited publications accumulated 39.5% of the 5,572 citations recorded. These results describe patterns of indexed dissemination and scholarly visibility at the established cutoff date; they do not constitute direct measures of research quality, social relevance, or regional impact.

Among the 263 publications involving local affiliations, production was concentrated primarily in the Universidad Veracruzana campuses, the Tecnológico Nacional de México campuses, and the Mexican

Institute of Social Security. PEMEX, private universities, municipal agencies, and other regional organizations participated less frequently in the retrieved publications. The collaboration maps documented connections among institutions at local, national, and international levels, although they did not measure the frequency, intensity, or structural importance of these relationships.

The findings portray a regional scientific landscape characterized by growing and multidisciplinary production, but also by unequal representation across indexed publication channels and institutions.

This characterization provides a baseline for research planning, the identification of thematic strengths and less represented areas, and the development of interinstitutional studies addressing the environmental, technological, socioeconomic, educational, and health-related challenges of the corridor. Its scope remains limited by the exclusive use of Google Scholar, whose broad coverage facilitates access to regional and multidisciplinary literature but does not ensure exhaustive retrieval or the standardized indexing provided by specialized bibliographic databases.

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