

BIBLIOMETRIC ANALYSIS OF THEMATIC NETWORKS IN CENTRAL ASIAN INTEGRATION LITERATURE: TRENDS, CLUSTERS, AND EMERGING RESEARCH DIRECTIONS

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ABSTRACT. *In this article, the scientific literature on integration processes in Central Asia was studied using the method of bibliometric analysis from the point of view of thematic networks. The purpose of the study is to identify the main directions of works covering the problems of integration, to show trends in their development, and to establish new prospects for future research. In the course of the analysis, three main clusters of scientific literature were identified: economic integration, regional development, and water resources management. In addition, new research areas related to economic development, environmental issues, and transport and logistics infrastructure have been identified. The results of the study show the main challenges and new opportunities for cooperation in the region and emphasize the need for a comprehensive consideration of integration processes. This article can serve as a methodological basis for scientific papers devoted to the study of integration ties in Central Asia in the future.*

KEYWORDS: *Central Asia, integration, regional development, economic integration, bibliometric analysis, network analysis.*

INTRODUCTION

The countries of Central Asia are known for their abundant natural resources as well as their rich historical and cultural heritage. It is known that in ancient historical periods, such important trade routes as the Silk Road passed through the territory of Central Asia. Central Asia, located between China and India in the East, the European world in the West, the Volga, and Siberia in the North, Persia, and Arabia in the South, for almost two millennia, stood at the intersection of great trade routes, world civilizations and cultures. Since gaining independence, the five Central Asian nations have maintained close ties, although each has pursued its own development path. The increase in GDP, trade indicators, population growth, and sustainable economic growth make it necessary to assess the role and prospects of the territory in a new way. Over the past 20 years, the average annual economic growth rate of Central Asian countries has been 6.2%. In comparison, the growth rate of other developing countries stands at 5.3%, while the global average is 2.6% annually (Eurasian Development Bank, 2022). It is known that

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after the collapse of the Soviet Union, the countries of Central Asia, which embarked on their own path of development, took several steps toward mutual cooperation. Despite the historical proximity and cultural and linguistic similarities that unite the Central Asian countries, there has not yet been a functioning integration association. However, these nations are forming their own unique cooperation initiatives. Now the five countries are witnessing a new stage of convergence of positions on the main areas of cooperation. Bilateral ties are strengthened, and consultative meetings of the heads of state are held regularly. Considering the mistakes of previous integration initiatives, the new regional agenda is based on pragmatic approaches and focuses on concrete results. In the vast majority of research studies that have studied the integration process in the Central Asian region, along with disintegration factors, more attention is paid to the relationship of the countries of the region with third actors. In the previous studies, the impact of external forces, various levels of economic development, language and religion problems, infrastructure imperfection, and geopolitical situation were noted among the factors that negatively affect the integration processes in the region. Until now, there have not been comprehensive reviews specifically focused on the integration processes in Central Asia that assess the current state of research in this area. Consequently, to bridge this research gap, this study conducted a bibliometric analysis of research on the integration process in the Central Asian region to summarize the literature in this area and consider possible future directions. Indeed, the countries of Central Asia must strive for mutual cooperation and take various steps. It appears that cooperation among these countries will be a key trend in the region's development over the next decade. Therefore, an examination of the present state of research on the level of cooperation among the Central Asian countries can offer valuable insights into scientific advancements in this field. Specifically, this study sought to fulfill the following research objectives (ROs):

RO1: analyze the evolution of publication count in the research field of the integration process in Central Asia;

RO2: determine the productive countries and most cited publications;

RO3: analyze the dominant themes in the literature on the integration process in Central Asia;

RO4: identify the emerging trends in the integration process in Central Asia.

This bibliometric study differs from previous reviews of the literature on Central Asia, paying special attention to the level of mutual cooperation of Central Asian countries. The research paper examines the data of 101 articles collected in the Scopus database. The results contribute to an overview of research trends in this area as of December 2024. Thus, this study is important in determining the level of study, and development trends of integration processes in Central Asian countries and brings to light the directions of future research.

Following this introduction, the paper is structured as follows: Section 2 presents a survey of existing literature on Central Asian integration processes. Section 3 outlines the methodology and data used in the study. Section 4 showcases the findings from the bibliometric analysis, while Section 5 summarizes the key conclusions drawn from the research.

LITERATURE REVIEW

Regional integration initiatives in Central Asia have encountered challenges due to weak institutions and conflicting national agendas. While organizations such as the Shanghai Cooperation Organization and the Eurasian Economic Union are active in the region, they are often viewed as tools of external powers like China and Russia, rather than as genuine platforms for regional collaboration. Peyrouse (2012) noted that the absence of robust, regionally driven institutions has impeded integration efforts, with energy cooperation remaining a particularly contentious issue due to diverse national objectives.

According to other scholars, authoritarian regimes in Central Asian countries are not inclined to share power with regional organizations, fearing a weakening of their control over strategic economic resources. Since leaders worry that pooling sovereignty and diminishing the significance of borders to facilitate flows of goods and people might have a detrimental impact on their control of strategic economic resources, incentives for deep cooperation to create a regional area of free (or even less controlled) movement are out of the question (Buranelli, 2021).

Some researchers argue that unresolved issues such as territorial disputes, water allocation, cross-border peoples, energy, and transport also negatively affect relations between the Central Asian States. The issues of water resources and energy in Central Asia are significant, as the region relies on two rivers—the Amu Darya and the Syr Darya—for 90 percent of its water supply. However, conflicts arise between upstream countries (Tajikistan and Kyrgyzstan), which have abundant water, and downstream countries (Uzbekistan, Kazakhstan, and Turkmenistan), which possess significant oil and gas resources (Lee et al., 2023).

Regionalism, which involves transferring part of sovereignty to supranational organizations, raises concerns among Central Asian States regarding the potential weakening of nationalism and national sovereignty. Currently, a major challenge facing regional integration organizations in Central Asia is the skepticism toward regionalism among the states and their populations. Additionally, a lack of intraregional powers capable of leading the integration process, along with varying views on regional identity, undermines collective identity and acts as a disintegrating factor (Cao, 2024).

Some authors believe that the integration of the countries of the region should be based on economic integration, solving mutually pressing problems. Political cooperation among the Central Asian Five will be possible only if it is strengthened by real economic integration, the formation of sustainable national economies, and the development of regional identity (Kazakhstan Institute for Strategic Studies, 2023). The EU, an example of a successful regional association, shows that it is necessary to start establishing effective cooperation in several key areas. This cooperation, which began with the successful operation of such an agreement as the European Coal and Steel Association (in 1951), is also an example for other regions. Effective cross-country interaction in Central Asia can be carried out within the framework of solving the most pressing issues of water resources allocation, energy complex, transport transit, border issues, and labor migration. To begin with, it will be possible to achieve an effective solution

to key issues in these areas and talk about a gradual increase in regional cooperation (Kushkumbaev, 2022, 158p.).

Other researchers, including Ateed and Özcan (2023), agree that the economy should play a significant role in regional integration in Central Asia. They reference Haas's theory of neo-functionalism, which suggests that the presence of a common need among countries in a region encourages cooperation in specific sectors. The Cantori and Spiegel Model illustrates how the economic strength of states, the patterns of foreign trade, and the nature of economic relations affect regional integration in a particular region (Cantori & Spiegel, 1969).

The Central Asian countries have not yet fully achieved economic integration, but the unifying forces outweigh the separating forces in the region's modern development. A key requirement for advancing integration in the region is developing a clear strategy for interstate cooperation that aligns with the interests of all Central Asian countries (Koichumanova, 2022). Another paper identifies the economic factor as a crucial element that has not yet been prioritized in regional and bilateral discussions. It suggests that a stronger emphasis on economic integration could facilitate closer ties and more effective cooperation among the countries (Delovarova et al., 2023).

The sources emphasize the role of Uzbek-Kazakh cooperation in stimulating regional cooperation, including in the energy sector (CAA Network, 2021). Experts of the Kazakhstan Institute for Strategic Studies under the President of the Republic of Kazakhstan have identified regional institutional formats and initiatives that are expected to increase their influence on Kazakhstan's foreign policy in the next 10 years. The survey results highlight the region-wide Central Asian framework, which extends to relations with China, Turkey, Russia, the United States, and the EU. Thus, Central Asia, in the eyes of international experts, serves as a foundation for Kazakhstan's interaction with external actors (Kazakhstan Institute for Strategic Studies, 2023). The Central Asian Barometer, an independent and non-profit institute for applied research and analytics, has analyzed the perspectives of the people in Kazakhstan and Uzbekistan regarding regional integration. As a whole, these responses seem to illustrate that many ordinary people within Kazakhstan and Uzbekistan consider themselves to have shared identities, practices, and values that unite them with other Central Asian nations. This sense of unity is reflected in the optimistic outlook that the respondents have on the current state of Central Asian cooperation and integration, and their positive feelings toward the possible integration (Central Asia Barometer, 2022).

The analysis of the texts of documents and speeches of the heads of state demonstrates the commitment of the Central Asian countries to the development and strengthening of cooperation in the region. The word "cooperation" is one of the most frequently found in the analyzed texts, which indicates the desire of the countries of the region to interact and solve common problems. The authors consider this as a possible starting point for the development of deeper integration in the future (Mukasheva & Akhmedyanova, 2024).

In the vast majority of previous written works that have studied integration processes in the Central Asian region, the emphasis is on internal and external factors affecting

integration. In addition, the influence of external actors and the geopolitical landscape of the region have been extensively studied. A bibliometric analysis of existing research on this subject helps gauge the relevance of the topic, assess the productivity of current studies, and identify key areas of focus. Based on this review of previous literature, it appears that a focused study examining the state of research on integration processes in Central Asia has yet to be conducted. This study aims to fill that gap.

METHODOLOGY

This study employed a bibliometric analysis approach to investigate the integration process in Central Asia, following the five-step science mapping framework outlined by Zupic and Čater (2015). As shown in Figure 1, the process was adapted for this research in a manner comparable to Lodhi et al. (2024). The diagram illustrates the five stages (research design, data collection, analysis, visualization, and interpretation) along with the corresponding actions and techniques for each phase. Initially, following the method of Lodhi et al. (2024), we surveyed databases to confirm the uniqueness of our research topic before proceeding with the study. As a result, we found previous literature reviews on Central Asia and only one bibliometric review, however, focused on research publications on Central Asia (Wang et al., 2015). We discovered that no bibliometric analysis had previously addressed the integration processes in this region. As a result, we established four research goals outlined in the introduction.

Following this, the next stage was keyword selection. The final keywords were determined by establishing search terms that aligned with the study's scope and drew upon previous reviews. We, therefore, considered “regional integration”, “economic integration”, “political integration”, “social integration”, “regional cooperation”, and “interstate relations” combined with “Central Asia” or “Central Asian countries” as the primary keywords to search the Scopus database using Boolean Operators “OR” and “AND” in the “Article title, Abstract, Keywords” search field. The Scopus database was chosen for its compilation of content from esteemed academic sources and its superior quantity of papers on the research topic compared to other databases. Scopus offers extensive coverage of interdisciplinary journals and publications in emerging fields, as well as a more comprehensive inclusion of books and conference proceedings than alternative databases. Consequently, this research utilized Scopus as the primary source for bibliometric data. Following previous studies and considering the comparable publication coverage between Web of Science and Scopus, along with the presence of lower-quality works in Google Scholar (Harzing & Alakangas, 2016), the decision was made to exclusively use Scopus for this study.

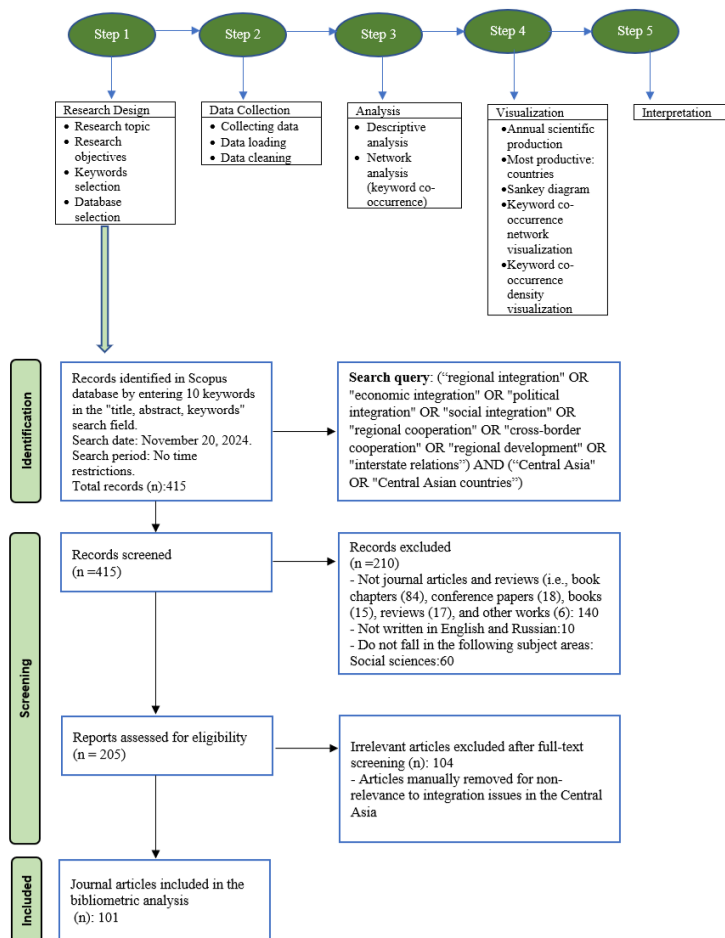
Data collection was the second phase of the process. On November 20, 2024, we gathered the necessary information without imposing any time restrictions. Our initial search of the database resulted in 415 documents related to our research topic for further evaluation. Firstly, the search was limited to the subject area “Social sciences,” so all the documents (60) that were not in the study field were excluded. Second, all materials other than journal articles were also removed, thus excluding a further 140 documents (including book chapters, conference papers, books, and reviews). Additionally, 10 articles that were not written in English or Russian were excluded, resulting in 205 articles meeting the study's inclusion criteria after evaluating their eligibility. During

the data loading and cleaning stage, we extracted a CSV file from the Scopus database containing all relevant data fields.

In the third phase of our process, which focused on data analysis, we utilized two software tools: RStudio's Biblioshiny package (Aria & Cuccurullo, 2017) and VOSviewer (Van Eck & Waltman, 2010). The Biblioshiny package was used for descriptive analysis, while VOSviewer was employed for network analysis, specifically keyword co-occurrence analysis. These two software packages enabled us to conduct the two types of analysis planned for the bibliometric study (Donthu et al., 2021). Bibliometric analysis encompasses not only evaluative techniques for assessing productivity but also relational techniques that determine networks between research papers, journals, or authors (Echchakoui, 2020). Keyword co-occurrence analysis allows for the examination of topic relationships in research works by identifying frequently occurring keywords and grouping them into thematic clusters. This method helps in understanding the primary themes within a field and predicting future trends (Donthu et al., 2021).

For the fourth phase, which involved data visualization, we employed the Biblioshiny package in RStudio to generate visual representations of annual scientific production, the most productive nations, and the most frequently cited publications, and to create a Sankey diagram (e.g., Khan et al., 2023), as well as to conduct thematic analysis. To visualize the co-occurrence network of keywords, VOSviewer was utilized (Van Eck & Waltman, 2010). This method involves creating a network of words that represent topics, which is then displayed on a map using network visualization techniques (Donthu et al., 2021). Additionally, we applied density visualization for keyword co-occurrence to identify areas with higher topic concentrations and their distribution within the network (Van Eck & Waltman, 2010). Both Biblioshiny and VOSviewer are effective tools for producing visual representations of literature, with graphs capable of highlighting hotspots, revealing new patterns, and illustrating complex networks within the scientific community (Gao et al., 2021). The final step, step five, involved describing and interpreting the findings (Zupic & Čater, 2015).

Research limitations – the analysis is based only on the Scopus database, so it may exclude relevant research papers indexed in other databases, like WoS or Google Scholar. Although Scopus provides high-quality data, future research should combine multiple databases to achieve comprehensive coverage of the field. In addition, this research focuses mainly on articles published in English and Russian, which may not take into account the significant contributions of sources written in another language.

Figure 1. Research methodology design

Source: compiled by the authors

RESULTS

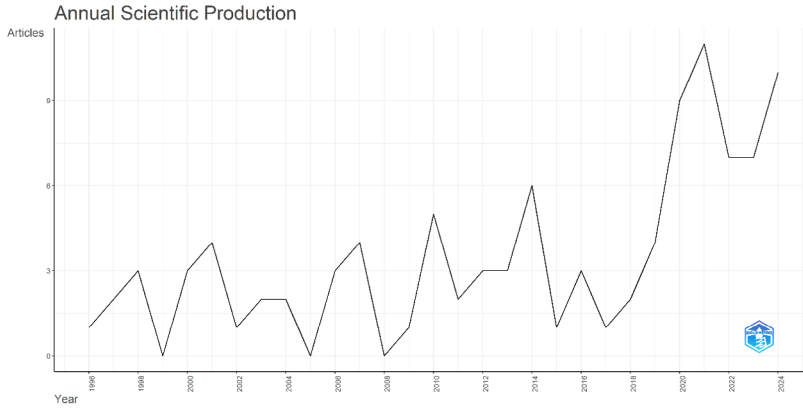
This segment presents findings on the development of academic literature regarding the integration process in Central Asia. It examines the most productive countries and the most cited publications in this field. Additionally, key themes are identified from the 101 selected articles through an analysis of keyword co-occurrence. A word cloud visualizes the most frequently used words, and a thematic map analysis is also provided for better understanding.

The Progression of Annual Scientific Production

The progression of the 101 chosen articles extracted from Scopus is illustrated in Figure 2. The linear pattern reveals that, over the 23 years from 1996 to 2019, the number of published research papers on the Central Asian integration process showed an unstable trend. To highlight the relevance of this research topic in recent years, it is important to note that the number of publications has increased significantly over the past five years.

Notably, 2021 emerged as the most productive year in terms of publication count. These observations suggest that the integration process of Central Asian nations has recently gained substantial attention among researchers.

Figure 2. Annual scientific production of research papers on the Central Asian integration process



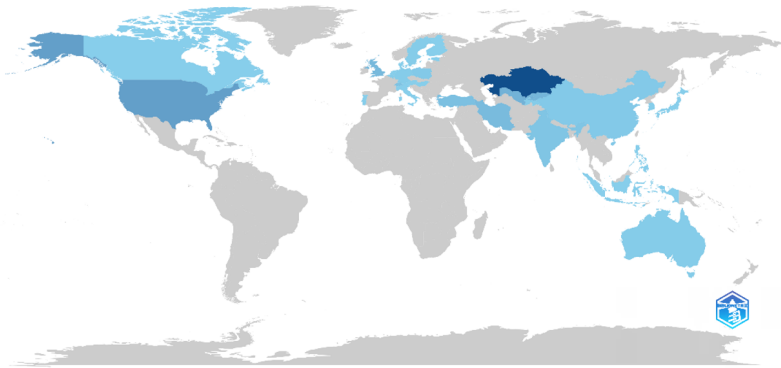
Source: compiled by the authors based on multiple sources from Scopus using Biblioshiny

Countries' Scientific Production

The map in Figure 3 illustrates the research output of various nations. Countries that produced the highest number of scientific publications are highlighted with bold coloration. Kazakhstan has contributed the most articles to the field (59 articles), followed by the USA (21 articles), Uzbekistan (13 articles), and Kyrgyzstan (11 articles). Additional details regarding these results can be found in Table 1.

Figure 3. Countries with the highest contributions to studies on Central Asian integration

Country Scientific Production



Source: compiled by the authors based on multiple sources from Scopus using Biblioshiny

From the information in Table 1, it is evident that researchers from both Central Asian and Western countries have contributed a significant number of research articles. This demonstrates the growing interest in integration processes within these nations.

Table 1. The number of articles per country

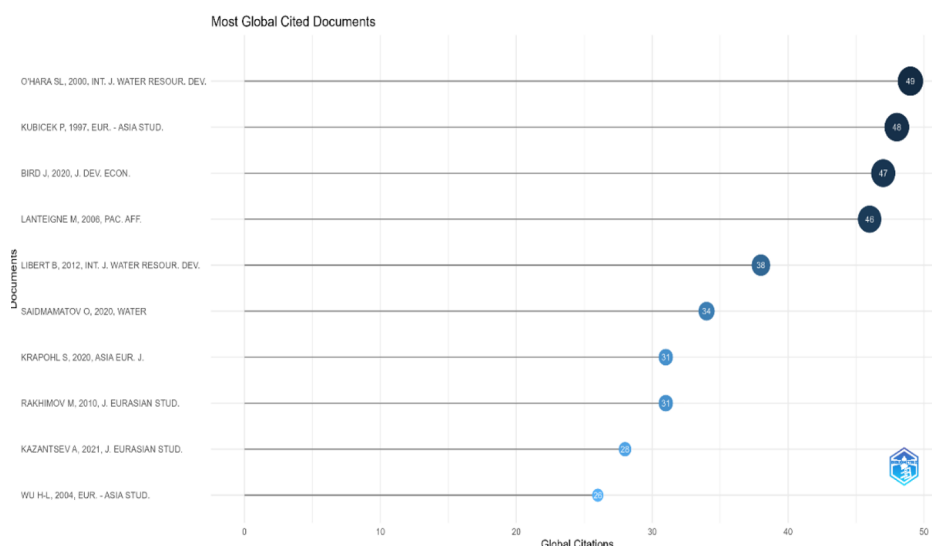
	Articles
KAZAKHSTAN	59
USA	21
UZBEKISTAN	13
KYRGYZSTAN	11
UK	10
IRAN	9
TURKEY	7
SWITZERLAND	6
INDIA	5

Source: compiled by the authors based on multiple sources from Scopus

The Most Frequently Cited Publications

Figure 4 provides information on the most cited works globally. Identifying the most frequently cited articles allows researchers to assess the significance of a topic within the academic community. The first article in the figure was cited 49 times, while the last one in the top ten was cited 26 times.

Figure 4. The most cited articles on the Central Asian integration process



Source: compiled by the authors based on multiple sources from Scopus using Biblioshiny

Table 2 below lists the most cited articles and the number of citations. According to the information in the table, cooperation between the countries of Central Asia in the field of economic and water issues is relevant among researchers. At the same time, research works on such topics as the dynamics, problems, prospects for the development of regional integration cooperation, and the influence of external actors are also relevant. In general, this means that many scientists study the region's integration efforts in detail.

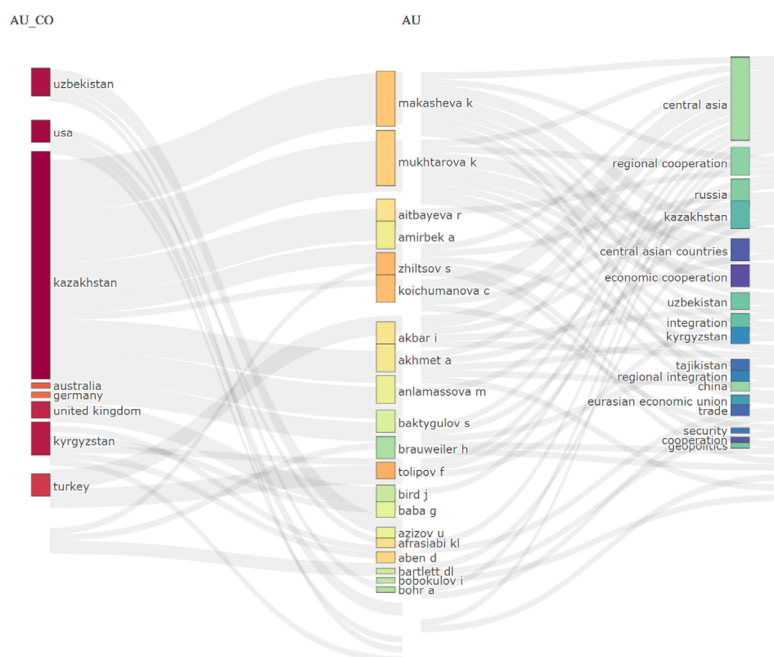
Table 2. The most cited articles

Title of the article	Total citations
Central Asia's water resources: Contemporary and future management issues	49
Regionalism, nationalism, and Realpolitik in Central Asia	48
The Belt and Road Initiative: Reshaping economic geography in Central Asia?	47
Challenges and opportunities for transboundary water cooperation in Central Asia: Findings from UNECE's regional assessment and project work	38
Water-Energy-Food nexus framework for promoting regional integration in Central Asia	34
The region that isn't: China, Russia, and the failure of regional integration in Central Asia	31
Internal and external dynamics of regional cooperation in Central Asia	31
Between Russia and China: Central Asia in Greater Eurasia	28
The prospects for regional economic integration between China and the five Central Asian countries	26

Source: compiled by the authors based on multiple sources from Scopus

Sankey Diagram

Valuable insights can be gained by examining the relationships between primary keywords (or topics), nations, and researchers. The Sankey diagram in Figure 5 illustrates the analysis of three fields within the literature related to the integration process in Central Asia. This diagram showcases the most significant connections between the countries of the authors' affiliations (on the left), the authors themselves (in the middle), and the keywords (on the right). The study highlights the most prominent keywords used by authors and key countries in the field of Central Asian integration. According to Figure 5, the most discussed topics in this research area include "Central Asia", "regional cooperation", "Kazakhstan", "Russia", "economic cooperation", "Central Asian countries", "Uzbekistan", "Kyrgyzstan", "integration", and "Tajikistan". The Sankey chart indicates that the majority of articles on this topic were authored by individuals from Kazakhstan, followed by those from Kyrgyzstan and the United States, which aligns with the findings presented in Figure 3 and Table 1.

Figure 5. Relationships among keywords, authors, and countries by three-field plot

Source: compiled by the authors

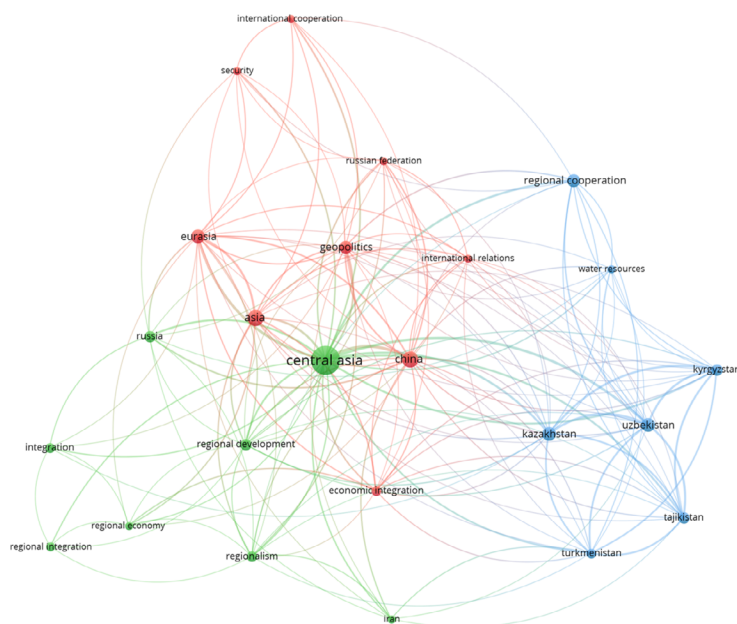
Keyword Co-Occurrence Analysis

The keyword co-occurrence network displayed in Figure 6 (generated using VOSviewer) illustrates the frequency with which specific keywords appeared in the 101 analyzed articles. This visualization technique enables easy identification of trending topics within a research field by examining the relationships between frequently used keywords. (Gao et al., 2021). To analyze keyword co-occurrence, we established a minimum threshold of five occurrences for each keyword. This resulted in a network of 24 keywords meeting the criteria, out of a total of 405 keywords in the database (including both author keywords and keywords plus). In the co-occurrence network, node size represents the frequency of keyword appearance in the articles. The network is composed of three keyword clusters, each denoted by a different color, representing groupings of related topics across the articles (Gao et al., 2021). This network visualization showcases prominent topics (represented by nodes) and their interconnections (depicted by lines) (Echchakoui, 2020). The strength of the relationship between two terms is indicated by their co-occurrence frequency; terms with higher co-occurrence indices are positioned closer together in the network, while those with lower indices are farther apart. An analysis of the three clusters shown in the network in Figure 6 follows.

Cluster 1 (Red): Central Asian economic integration. The initial significant cluster identified comprises 9 key terms, with "economic integration" at the forefront, followed by "geopolitics" and "international cooperation". Additional crucial terms encompass "international relations", "Eurasia", "China", "Russian Federation", and

"security". This cluster therefore represents investigations into the interplay between economic integration, international cooperation, and external players. It examines how the economic collaboration among Central Asian nations is linked to factors such as security concerns, geopolitical dynamics, and the impact of outside forces.

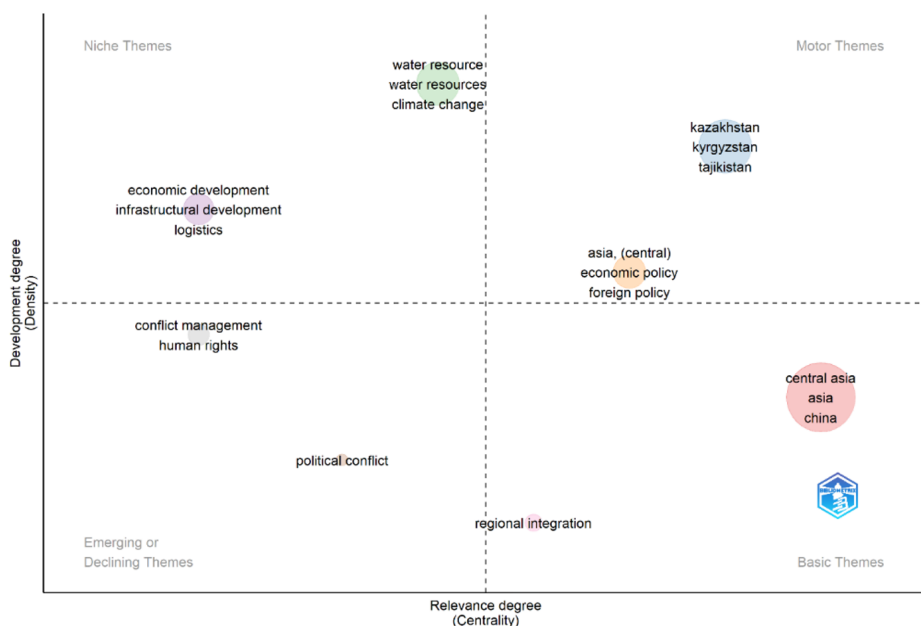
Figure 6. Visualization of keyword co-occurrence network



Source: compiled by the authors based on multiple sources from Scopus using VOSviewer

Cluster 2 (Green): Regional development in Central Asia. The second main group comprises 8 key terms, with "Central Asia" as the leading keyword, closely followed by "regional development," both showing the highest frequency of co-occurrence. This group also encompasses phrases such as "regional economy," "regionalism," "regional integration," "integration," "Russia," and "Iran." The composition of this cluster indicates that the research in this area primarily concentrates on the efforts toward regional development and integration within Central Asia. Terms such as "Russia," and "Iran" reflect the influence of external actors who impact the region.

Cluster 3 (Blue): Five Central Asian countries and regional cooperation on water resources. The third major grouping consists of 7 keywords which are led by the term "regional cooperation" followed by "water resources" and the names of Central Asian states. The names of all five Central Asian countries are one of the main pillars of the research topic. During the review of the general literature, the relevance of such topics as the effective use of water resources, and the solution of mutual problems was noted. Therefore, the topic of cooperation in the field of water sources is becoming a priority in this cluster.

Figure 9. Thematic map

Source: compiled by the authors based on multiple sources from Scopus using Biblioshiny

CONCLUSION

In conclusion, this study sought to identify the main thematic areas of scientific literature concerning integration issues in Central Asia and to trace their evolution through bibliometric analysis. The results demonstrate the dynamics of research development across various aspects of Central Asian integration, highlighting key scientific clusters, and emerging research areas. Several important trends were identified during the bibliometric analysis. Firstly, regional economic and trade relations, as well as regional development, are significant areas of research. Secondly, topics related to water management and cross-border environmental issues frequently arise among the topical clusters. This indicates that Central Asia's reliance on natural resources and their impact on integration processes are focal points for researchers. Thirdly, newly identified directions during the study, including economic development and enhancements in transport and logistics infrastructure, suggest that new opportunities and challenges are emerging within the framework of Central Asian integration. These areas are likely to become important research focuses in the future.

Overall, the variety of thematic networks in the literature examining integration processes highlights the complex nature of regional cooperation. Future research should also encompass the institutional structure, legal framework, and socio-cultural aspects of integration. It is essential to acknowledge that the integration process, aimed at addressing specific economic challenges while requiring a holistic approach, will

ultimately be beneficial. Such research could serve as a foundation for developing effective solutions to deepen cooperation in the region.

This analysis will enhance understanding of the current state of research on integration processes in Central Asia and identify priority areas for future investigation. It is crucial to effectively leverage new opportunities for regional integration to ensure sustainable development and economic growth in the region.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

AUTHORS' CONTRIBUTIONS

GY: conceptualization and data curation, formal analysis and investigation, resources, visualization, writing – original draft; AD: project administration, resources, supervision; RL: methodology, software, validation, writing – review & editing.

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