

Bibliometric Analysis of Urbanization in Arid Regions Based on Scientific Knowledge Graphs: Postprint

Authors: Zhou Chunshan

Date: 2022-04-16T00:54:06+00:00

Abstract

Through CiteSpace analysis of 2,703 articles on arid area urbanization research from CNKI (China National Knowledge Infrastructure) spanning 1984–2020, this study examines publication trends, stage division, core author and institutional networks, thematic evolution, and historical hotspots utilizing temporal distribution of publications, author and institution co-occurrence, keyword co-occurrence, and burst detection. The publication volume of relevant research first increased and then decreased, which can be divided into four periods: embryonic, rapid, vigorous, and mature. Numerous institutions and scholars with distinguished contributions have emerged. In the knowledge evolution, scholars have focused on research themes including small town development and township enterprises, urbanization processes and driving forces, Corps urbanization, new-type urbanization, and eco-environmental coupling coordination, while historical hotspots such as industrialization, the Silk Road Economic Belt, and characteristic towns have emerged sequentially. This paper provides theoretical insights for reflecting on urbanization in arid areas and offers references for promoting high-quality development and new-type urbanization in these regions.

Full Text

Bibliometric Analysis of Urbanization Research in Arid Lands Based on Knowledge Mapping

ZHOU Chunshan^{1,2}, CHEN Kairui¹, Bahram ZIKIRYA³

¹School of Geography and Planning, Sun Yat-sen University, Guangzhou 510275, Guangdong, China

²Key Laboratory for Sustainable Development of Xinjiang Historical and Cultural Tourism, Xinjiang University, Urumqi 830049, Xinjiang, China

³College of Tourism, Xinjiang University, Urumqi 830049, Xinjiang, China

Abstract

Arid lands, as a typical region of western China, play a crucial role in China's regional development strategy and have attracted significant scholarly attention. Urbanization, as an essential pathway for national development, has become a vital topic in academic research. Influenced by national macro-policies, research on urbanization in arid lands continues to emerge, with its knowledge framework constantly evolving. Although reviews exist in specific fields, no comprehensive synthesis has been conducted on the knowledge evolution of arid land urbanization. This paper systematically examines the knowledge evolution process of arid land urbanization research, analyzing research trends and hotspots to provide foundational contributions for future studies, support critical reflection on arid land urbanization, and promote high-quality development and new urbanization in these regions.

To systematically review the research landscape and knowledge evolution, we analyzed 2,703 articles on arid land urbanization from 1984 to 2020 using bibliometric analysis and knowledge mapping visualization techniques. Our dataset comprised research papers from Chinese core journals (including Peking University Core Journals, Chinese Science Citation Database, and Chinese Social Sciences Citation Index) and dissertations collected in the China National Knowledge Infrastructure (CNKI). We examined quantitative publication characteristics, scientific collaboration networks among core authors and institutions, research themes, and historical hotspots across different periods through temporal distribution analysis, co-occurrence mapping of authors and institutions, keyword co-occurrence analysis, and burst term detection, summarizing their evolutionary patterns.

The findings reveal three key insights. First, the research can be divided into four distinct periods, with numerous important institutions and scholars emerging. Publication volume initially increased then decreased, allowing division into four stages: nascent (1984–2001), rapid growth (2002–2010), flourishing (2011–2015), and maturity (2016–2020). Apart from the Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences (CAS) and the University of Chinese Academy of Sciences, the primary publishing institutions are universities located in arid regions, while many scholars have made outstanding contributions. Second, new research topics and hotspots continuously emerge. Throughout the knowledge evolution, scholars have focused on small towns and township enterprises, urbanization processes and driving forces, Xinjiang Production and Construction Corps urbanization, new urbanization, and ecological environment coupling coordination. Industrialization, the Silk Road Economic Belt, and characteristic towns have also become historical hotspots. Third, arid land urbanization research is closely linked to policy contexts of each period. The Western Development Strategy, Central Poverty Alleviation and Development Work Conference, and the 19th National Congress of the Communist Party of China have introduced development concepts such as small town development, new urbanization, sustainable development, and rural

revitalization, all of which are fully reflected in arid land urbanization research across different periods. This demonstrates that such research plays a crucial role in implementing national and regional development strategies and exploring urban-rural development in arid lands. Future research should focus more on high-quality development.

Keywords: urbanization; arid land; research hotspots; bibliometric analysis; CiteSpace

1. Data and Methods

1.1 Data Sources

This study examines papers on arid land urbanization published between 1984 and 2020, sourced from the China Academic Journals Full-text Database. Initial searches using the theme terms “arid land” combined with “urbanization” or “urbanisation” yielded limited results. To comprehensively capture relevant research, we expanded the search to include specific regional names associated with arid lands. According to China’s dry-wet zoning map, arid regions are areas below the 200 mm isohyet, encompassing Xinjiang, Tibet, Qinghai, Ningxia, Inner Mongolia, and Gansu. We also included the closely related term “oasis.” Therefore, we searched for combinations of regional terms (“arid land,” “Xinjiang,” “Tibet,” “Qinghai,” “Ningxia,” “Inner Mongolia,” “Gansu,” “oasis”) with theme terms (“urbanization,” “urbanisation”) in Chinese core journals (Peking University Core, Science and Technology Core, and Nanjing University Core) and dissertations. The Nanjing University Core journal list was last published in 2009; we searched all journals before 2009 and Chinese core journals thereafter. After removing duplicates and eliminating conference proceedings and other irrelevant content, we obtained 2,703 valid documents containing paper titles, authors, institutions, publication dates, keywords, and abstracts.

1.2 Research Methods

Term frequency analysis identifies research hotspots by extracting and analyzing the frequency distribution of core thematic terms from literature information, while co-word analysis reveals relationships between terms through co-occurrence frequency. Co-occurrence analysis integrates both approaches. Author and institution co-occurrence analysis can identify core author groups and corresponding institutions, uncovering collaborative network relationships within specific time periods. Keyword co-occurrence analysis helps organize research themes within each period and understand their evolution. In knowledge maps, node size and inner ring colors represent term frequency and first appearance time, respectively; line thickness and color indicate connection strength and first connection time; and purple outer rings denote high betweenness centrality. Burst term detection, using the Kleinberg algorithm, effectively identifies suddenly emerging research hotspots, uncovers new research directions,

and determines their emergence and duration, serving as an important indicator of research focus shifts. Pathfinder and minimum spanning tree algorithms can simplify 图谱 and optimize visual presentation. The Pathfinder algorithm better highlights important structural features and offers completeness (unique solution), so we used it to prune complex networks and retain clear structural information.

2. Results

2.1 Publication Volume Analysis

Arid land urbanization research is closely related to policy contexts. To accurately analyze the evolution of scientific knowledge mapping across different periods, we divided the research into four developmental stages based on annual publication numbers, growth patterns, and corresponding historical events: nascent (1984–2001), rapid growth (2002–2010), flourishing (2011–2015), and maturity (2016–2020). Overall publication volume first increased then decreased, peaking in 2015. Before 2001, scholars paid limited attention to arid land urbanization, with annual publications remaining below 20. Following the implementation of the Western Development Strategy in 2000, publication volume generally increased year by year, surpassing 100 for the first time in 2002 and entering a rapid growth phase. The 12th Five-Year Plan period (2011–2015) saw a significant acceleration in publications, ushering in a flourishing period. Entering the 13th Five-Year Plan period (2016–2020), the research field matured, with scholars' attention gradually decreasing and research 热度 declining year by year.

2.2 Core Authors and Institutions

Co-occurrence analysis of authors and institutions reveals core groups and collaborative relationships. We conducted separate analyses for the four periods (Figures 3 and 4), setting node thresholds at 2 for the nascent period (labeling nodes with word frequency >2) and 3 for other periods. Due to simple structural relationships, no network pruning was applied.

During the nascent period, both author and institution collaboration networks were in their infancy. No large academic groups emerged, with authors and institutions remaining relatively dispersed. Prolific authors included Ma Wenxing and Su Bin, while key institutions included Xinjiang University of Finance and Economics.

The rapid growth period showed clear collaborative relationships. Zhang Xiaolei and Fang Chuanglin made outstanding contributions, forming two major academic groups: one comprising Zhang Xiaolei, Du Hongru, Lei Jun, and Yang Degang from the Xinjiang Institute of Ecology and Geography, CAS; another including Fang Chuanglin, Qiao Biao, Bao Chao, and Sun Xinliang from the Institute of Geographic Sciences and Natural Resources Research, CAS. The

largest institutional collaboration network formed among the Xinjiang Institute of Ecology and Geography, CAS, Shihezi University, and Xinjiang University.

In the flourishing period, Zhang Xiaolei and Du Hongru remained prominent, with Zhang Xiaolei, Du Hongru, Anwar Maimaitiming, Dong Wen, and Yang Yu forming the largest author collaboration network. The largest institutional network comprised the Xinjiang Institute of Ecology and Geography, CAS, and the Institute of Geographic Sciences and Natural Resources Research, CAS.

During the maturity period, Li Jing, Zibibula Simayi, and Fang Chuanglin made significant contributions, forming teams led by Fang Chuanglin, Zhang Xiaolei, Lei Jun, and Yang Zhen from CAS, and Mi Wenbao from Ningxia University. Xinjiang Agricultural University joined the major academic network comprising the Institute of Geographic Sciences and Natural Resources Research, CAS, and the Xinjiang Institute of Ecology and Geography, CAS.

3. Theme Evolution and Historical Hotspots

3.1 Theme Evolution

Keywords distill the core research themes of papers. Analyzing keyword co-occurrence can uncover research topics within each stage and trace their evolution. We conducted keyword co-occurrence analyses for the four periods (Figure 6) and summarized the results (Table 1), setting time slices to 1 year. Except for the nascent period where node threshold was set to 2 due to limited publications, all other periods used a threshold of 3. We extracted the top 15 keywords per time slice and pruned complex networks using the Pathfinder algorithm.

The timezone view reveals that arid land urbanization research is temporally connected, continuously generating diverse themes such as urbanization level, sustainable development, and new urbanization. Research regions gradually shifted from Inner Mongolia to Xinjiang and Ningxia. Due to time lags in literature dissemination, recent topics show lower connectivity and frequency than earlier years, with no major research themes yet emerging. To further explore theme evolution, we analyzed each period separately.

3.1.1 Nascent Period (1984-2001) During this period, research focused on Inner Mongolia and Xinjiang, concentrating on population urbanization. Scholars calculated urbanization levels using urban population and non-agricultural population data, employing grey dynamic systems, unary regression, and growth curve models for predictions. Small towns and township enterprises generated considerable discussion. Ning Yuemin argued that China experienced a new urbanization process during this period, with coastal regions showing diversified drivers while inland arid regions maintained a dual urbanization pattern (top-down and bottom-up). The former promoted urbanization in large and

medium-sized cities, particularly industrial metropolises, while the latter emphasized the importance of township enterprises for small town and rural urbanization. In arid regions, bottom-up urbanization increased small town functions through township enterprise development, accommodated agricultural surplus labor, transformed occupational structures, and achieved functional urbanization before developing into landscape urbanization. Fang Chuanglin recognized these as fundamental drivers of oasis rural urbanization in arid lands.

However, scholars cautioned that while township enterprises significantly promoted urbanization in eastern coastal areas, their role in arid regions required careful consideration. Structural differences, particularly in tertiary industry, investment structure, and openness, limited the urbanization-promoting capacity of township enterprises in arid regions. Arid region towns remained in a “point” development stage with agricultural-centered economies, lacking mechanisms for rural industries to access cheap labor. Universal small town development across the region was deemed unrealistic. Consequently, some scholars advocated for prioritizing central cities over small towns, while others emphasized developing medium-sized cities and constructing medium-scale urban networks.

Amid rapid urbanization, sustainable development and ecological protection concepts gradually emerged. The relationship between urbanization and ecological environment in arid lands was characterized by mutual stress, mutual promotion, and interactive coercion. Water resources, as the most important natural factor and constraint condition, gained increasing attention. Research on spatiotemporal precipitation variations in arid regions indicated that uncertainty in anthropogenic greenhouse gas and sulfate aerosol emissions caused climate change uncertainty, making water resources a critical external force determining urbanization speed and socioeconomic scale. Oasis expansion essentially represented water resource utilization processes, while urban expansion simultaneously stressed water resources. The “mountain-oasis-transition zone-desert” model reflecting water resource distribution became a new approach for ecological protection. Against this backdrop, ecological migration research emerged, beginning with Ningxia’s “Sanxi” agricultural construction plan and gradually spreading across arid regions as a means to maintain ecosystem balance through active relocation, achieving harmony between humans and resources.

3.1.2 Rapid Growth Period (2002–2010) Following the Western Development Strategy and entering the 10th Five-Year Plan period, arid land urbanization research entered a growth phase with increasing publications. Research regions expanded to include Ningxia and Tibet, with subsequent studies concentrating on these four provinces/autonomous regions. Building upon urbanization level studies, substantial research emerged on urbanization processes, development stages, and driving forces. Xinjiang’s urbanization was transitioning from initial to rapid development stages, with lagging non-agriculturalization and uncoordinated growth rates between urbanization level and GDP. Industrialization was identified as the primary driving force for urbanization, with

low urbanization levels attributable to insufficient industrialization. While efficient capital flow significantly promoted urbanization in coastal regions, limited regional investment environments and weak capital agglomeration capacity constrained its effectiveness in arid lands. Influenced by multi-ethnic settlement patterns, ethnic trade and Chinese national culture became important urban development drivers.

The concept of sustainable development gained prominence. The relationship between urbanization and ecological environment was characterized by mutual stress, mutual promotion, and dynamic coupling through interactive coercion. Economic urbanization induced greater ecological risks than population or social urbanization. Environmental quality assessment using matter-element models became important. Water resource constraints received increasing attention, with research showing that water resources determine urbanization speed and socioeconomic scale in arid lands. Ecological migration, beginning with Ningxia's "Sanxi" project, emerged as a beneficial exploration of arid land urbanization, representing a new model distinct from other regions. Ecological risk and environmental quality evaluation became crucial for sustainable urbanization.

3.1.3 Flourishing Period (2011-2015) During this period, scholars widely discussed the unique Xinjiang Production and Construction Corps (XPCC). As an organization primarily responsible for reclamation and border defense, XPCC initially comprised collectively demobilized soldiers, gradually forming a four-level urban system of "Corps-Division-Regiment-Company" with a development approach of "divisions building cities, regiments building towns." Its unique "party-government-army-enterprise" integration created a "quasi-government" with public service functions but no fiscal power, while also possessing enterprise attributes requiring tax payments. XPCC's numerous non-established towns created a separation of financial authority and administrative power distinct from established towns, constraining urbanization progress.

Following the 18th National Congress's articulation of new urbanization, this concept became a major research theme. The 10th anniversary of Western Development prompted scholars like Zhang Xiaolei and Anwar Maimaitiming to reflect on characteristics such as high urban system primacy, "large dispersion with small concentration" layout, water-land resource constraints, fragile ecological foundations, and urban function isomorphism, proposing new urbanization pathways. New urbanization emphasizes coordinated unification of population, resources, environment, and economy, manifesting in arid lands as a process of mutual adaptation between humans and oasis environments. Industrialization, particularly new industrialization, remains indispensable. While new industrialization lags behind new urbanization in development level and growth rate, they maintain a cointegrated coupling relationship with high mutual influence and dependency.

Research expanded to include oasis rural settlements, oasis towns, reclamation areas, and pastoral regions. Zhang Xiaolei, Lei Jun, and Duan Zuliang systemat-

ically summarized nearly 20 years of oasis urbanization patterns, processes, and mechanisms. Oasis rural settlement evolution was driven primarily by natural environment and transportation conditions, distinct from economic and social factors like urban-rural gaps and urban land expansion in eastern and central regions. Oasis urbanization represents a self-organized critical phase transition process of oasis territorial systems centered on humans, with competition-coordination mechanisms as evolutionary drivers.

Following the 2015 Central Poverty Alleviation and Development Work Conference, urban-rural integration shifted toward coordinated urban-rural economic development and growth promotion. Moderate-to-high economic growth is a prerequisite for sustainable development in arid lands. In Ningxia, improvements in citizenization and agricultural support levels reduced urban-rural income gaps, while industrialization and per capita GDP had opposite effects. In deeply impoverished contiguous areas of southern Xinjiang, industrial structure, urbanization rate, and per capita GDP showed lagged significant impacts on per capita income. However, since economic growth and urbanization had not formed a mutually reinforcing relationship, caution was needed regarding urbanization models relying solely on economic growth. Economic growth's pressure on the ecological environment continued increasing, with oasis urban economic system vulnerability decreasing with city size and rank, necessitating economic transformation and industrial upgrading for sustainable oasis city development.

Ecological environment studies commonly used entropy methods to construct evaluation indicator systems and coupling coordination methods to analyze interaction mechanisms. The coupling relationship between urbanization and ecological systems showed 磨合 (running-in) and antagonism characteristics, with urbanization sacrificing environment and continuously increasing ecological pressure, though the rate of increase was slowing. Environmental pollution and urbanization processes followed the Kuznets curve, potentially forming a new pattern of positive interaction. The two systems exhibited interactive stress, antagonistic effects, and complementary adaptation. While urbanization stressed water and land resources, environmental elements also constrained urbanization. Rapid urbanization construction and slow ecological improvement caused the systems to shift from urbanization-lagged to ecology-lagged types, though overall moving from disorder to coordination.

3.1.4 Maturity Period (2016-2020) During this period, publication volume declined yearly while paper quality significantly improved, with new urbanization becoming the mainstream research topic. Beyond measuring new urbanization levels, scholars focused more on influencing factors and driving forces. XPCC construction, counterpart assistance to Xinjiang, and ecological environment were identified as factors distinct from eastern and central regions, with infrastructure playing a more significant role in arid lands.

New urbanization driving force research covered oasis rural areas, oasis towns,

reclamation areas, and pastoral regions. Zhang Xiaolei, Lei Jun, and Duan Zuliang systematically summarized oasis urbanization patterns, processes, and mechanisms. Oasis rural settlement evolution drivers primarily included natural environment and transportation conditions, clearly distinct from economic and social factors like development, urban-rural gaps, and urban land expansion in eastern and central regions. Oasis towns essentially represent the overall emergence of human-centered oasis territorial systems in multi-dimensional spatiotemporal functions and structures, with urbanization processes (formation, transformation, evolution) representing self-organized critical phase transitions driven by competition-coordination mechanisms. Reclamation areas in Xinjiang are cornerstones of border stability. From a regional security perspective, reclamation areas transitioning to new urbanization emphasize creating livable environments, reducing urbanization costs, transforming regional governance, and solving development imbalances, environmental fragility, and population loss.

In pastoral urbanization with Inner Mongolian characteristics, ecologicalization, industrialization, and settlement profoundly influence pastoral town distribution patterns and development. New pastoral urbanization emphasizes urban spatial agglomeration, with water sources, grasslands, and transportation as gravitational factors. Following the 19th National Congress' s rural revitalization strategy, research on rural settlements emerged, alongside considerable attention to characteristic towns.

3.2 Historical Hotspots

The sudden appearance of new keywords often signals scholars' attention to new research hotspots and indicates research turning points. Burst term detection helps identify historical hotspot topics and their durations, serving as an important supplement to theme evolution. The nascent period had insufficient publications for burst detection; results for other periods are shown in Figure 7.

During the rapid growth period (2002-2010), most emerging hotspots related to Inner Mongolia, Xinjiang, and western regions. Small town research continued to surge, covering non-agricultural population, industrialization processes, and development strategies. Industrialization-related research subsequently became a hotspot.

In the flourishing period (2011-2015), the 10th anniversary of Western Development prompted extensive reflection on arid land urbanization. New urbanization emerged as a timely hotspot, focusing on oasis towns unique to arid regions and examining relationships between urbanization, population, and resources, emphasizing coordinated human-environment development. With the rise of rural urbanization, research on agricultural modernization, farmers and herders, and financial support for urban-rural income also emerged. During this period, cluster analysis became popular in ecological research.

In the maturity period (2016-2020), the Silk Road Economic Belt, as a crucial corridor for external development in arid and western regions, became a

research focus in 2016. Studies increasingly focused on the Tianshan North Slope Urban Agglomeration, with content shifting toward spatial econometrics including spatial correlation and Durbin models. Following the 19th National Congress' s rural revitalization strategy, research on rural settlements gained prominence, and characteristic towns received substantial attention.

4. Conclusions and Outlook

This study reveals three main conclusions. First, arid land urbanization research can be divided into four stages, with many important institutions and scholars emerging. Publication volume first rose then fell, dividing into nascent (1984–2001), rapid growth (2002–2010), flourishing (2011–2015), and maturity (2016–2020) periods. Apart from CAS' s Institute of Geographic Sciences and Natural Resources Research and the University of Chinese Academy of Sciences, publishing institutions are primarily universities in arid regions, with many scholars making outstanding contributions.

Second, research continuously deepens, with new themes and hotspots constantly emerging. Thematic evolution has concentrated primarily on Xinjiang and Inner Mongolia. The nascent period focused on urbanization level measurement, small town development, and township enterprises. The rapid growth period examined urbanization processes and driving forces while beginning to address sustainable development. The flourishing period saw extensive discussion of XPCC urbanization unique to arid lands, with new urbanization emerging as a guiding pathway. The maturity period focused on urban-rural economic coordination and growth under urban-rural integration, and on coupling coordination between urbanization and ecological systems. Historical hotspots have sequentially included industrialization, Silk Road Economic Belt, and characteristic towns.

Third, arid land urbanization research is closely associated with period-specific policy contexts. Development concepts proposed for arid lands—such as small town development, new urbanization, sustainable development, and rural revitalization—are fully reflected in research, demonstrating its important role in implementing national and regional development strategies and exploring urban-rural development in arid regions.

Arid land urbanization is currently at a critical strategic opportunity period during the 14th Five-Year Plan. Transforming development concepts and promoting high-quality economic development impose higher requirements on future research. First, innovation as an increasingly important development driver is reshaping urban spatial patterns, with smart cities, digital economy, innovation chains, and big data becoming important considerations. Second, as an important component of human-land relationship regional system theory and human-land system science, arid land urbanization research should focus on coordinated development of population, land, and social urbanization, emphasizing collabo-

rative development of urban agglomerations and metropolitan areas under Silk Road Economic Belt opportunities, characteristic town construction in special arid environments, and rural revitalization for breaking urban-rural dual structures. Finally, arid land urbanization initially emerged as a social science topic but gradually integrated with physical geography and ecology due to natural environmental constraints. Future research should consider advancing theories on near-remote coupling between urbanization and ecological environment, and achieving Beautiful China and urban carbon neutrality planning goals based on dual evaluations in territorial spatial planning.

Arid land urbanization is a complex social issue with diversified research involving geography, ecology, sociology, and economics. This paper focuses on analyzing the knowledge evolution of Chinese literature, examining only high-frequency keywords without addressing detailed evolution within each field, foreign language journals, or thematic classification by discipline. Future research should enrich data sources, exploring detailed evolution within multidisciplinary fields in both Chinese and English literature contexts to map more precise scientific knowledge evolution.

References

- [1] Xu Xueqiang, Zhou Yixing, Ning Yuemin. *Urban Geography*[M]. Beijing: Higher Education Press, 2009.
- [2] Qiu Baoxing. The main lessons of urbanization abroad[J]. *City Planning Review*, 2004, 28(4): 8-12.
- [3] Liu Yaobin, Li Rendong, Song Xuefeng. Grey associative analysis of regional urbanization and eco-environment coupling in China[J]. *Acta Geographica Sinica*, 2005, 60(2): 237-247.
- [4] Rui Yang. Study on the appropriate mode and planning strategy of the development of urbanization of arid areas[D]. Xi'an: Xi'an University of Architecture and Technology, 2009.
- [5] Cheng Weiming, Zhou Chenghu, Li Jianxin. Economic development and oasis growth at the north foot of the Tianshan Mountains[J]. *Acta Geographica Sinica*, 2002, 57(5): 561-568.
- [6] Du Hongru, Zhang Xiaolei. A study on urban spatial agglomeration in Xinjiang in recent years[J]. *Scientia Geographica Sinica*, 2005, 25(3): 3268-3273.
- [7] Gong Xinchu, Xu Wenqian. Analysis on regional differences and determinants of urbanization progress in Xinjiang[J]. *Northwest Population Journal*, 2010, 31(4): 93-96, 103.
- [8] Chen Yue, Chen Chaomei, Liu Zeyuan, et al. The methodology function of CiteSpace mapping knowledge domains[J]. *Studies in Science of Science*, 2015,

33(2): 242-253.

[9] Li Jie, Chen Chaomei. *CiteSpace: Science and Technology Text Mining and Visualization*[M]. Beijing: Capital University of Economics and Business Press, 2016.

[10] Liu Kai, Lu Minying, Li Xiaoling. The bibliometric analysis on the 40th anniversary of *Tropical Geography* based on CiteSpace[J]. *Tropical Geography*, 2020, 40(6): 957-969.

[11] He Shujin, Liu Changming, Yuan Zhenjie. Development of geographical research in China through the lens of publication in the *Acta Geographica Sinica* between 1934 and 2018[J]. *Acta Geographica Sinica*, 2019, 74(11): 2209-2229.

[12] Sun Wei, Mao Lingxiao. Evolution of research on Beijing-Tianjin-Hebei co-operative development based on CiteSpace method[J]. *Acta Geographica Sinica*, 2018, 73(12): 2378-2391.

[13] Zhou Chunshan, Xie Wenhai, Wu Jilin. Review and prospect of regional planning practices and theories in China since the reform and opening up[J]. *Areal Research and Development*, 2017, 36(1): 1-6.

[14] Cui Xin, Wang Jinhui, Li Jie. Analysis of knowledge graph of pool fire research with CiteSpace[J]. *Fire Science and Technology*, 2019, 38(11): 1618-1623.

[15] Hu Zewen, Sun Jianjun, Wu Yishan. Research review on application of knowledge mapping in China[J]. *Library and Information Service*, 2013, 57(3): 131-137.

[16] Zhang Xiaolei, Du Hongru. New type of urbanization in arid zone of China: Regional characteristics and strategical choice of sustainable development path[J]. *Bulletin of Chinese Academy of Sciences*, 2013, 28(1): 46-53.

[17] Lin Zirong, Zhang Xiaolei, Zhu Zi'an, et al. Study on arid region oasis eco-environment and Xinjiang urbanization[J]. *Journal of Arid Land Resources and Environment*, 2007, 21(12): 6-14.

[18] Li Xiangyun, Wang Lixin, Zhang Yushu, et al. Analysis of roles of human activities in land desertification in arid area of northwest China[J]. *Scientia Geographica Sinica*, 2004, 24(1): 68-75.

[19] Shi Yulong, Ai Nanshan. Preliminary study on urbanization path in arid area of China[J]. *Journal of Lanzhou University (Social Science)*, 1989, 5(4): 37-44.

[20] Huang Xunfang. Rural development gap between eastern and western in China and its countermeasures[J]. *Issues in Agricultural Economy*, 1997, 2(3): 5-8.

[21] Li Tao. A comparative study of urbanization between Tibet and inland coastal areas[J]. *Ethno-National Studies*, 1999(1): 31-43.

- [22] Su Bin. The choice of urbanization path in Xinjiang[J]. *Finance & Economics in Xinjiang*, 1995, 7(4): 25-26.
- [23] Lu Yinong. Thinking on development strategy of Xinjiang cities[J]. *Urban Planning Forum*, 1996(1): 49-52, 56-66.
- [24] Lü Bin, Zhang Xiaolei. Study on coordination of urbanization and economic development in Xinjiang[J]. *Arid Land Geography*, 2002, 25(2): 189-192.
- [25] Yang Degang, Li Xiuping, Han Jianping, et al. Analysis of development process and dynamic mechanisms of urbanization in Xinjiang[J]. *Arid Land Geography*, 2003, 26(1): 50-56.
- [26] Fang Chuanglin, Zhang Bo. Study on the development and layout of the town system in oases of Gansu[J]. *Journal of Northwest Normal University (Natural Science)*, 1993, 29(1): 55-60.
- [27] Hu Yi, Dong Yongmao. Forecast of urbanization level of Xinjiang population[J]. *Northwest Population Journal*, 1991, 3(3): 10-15.
- [28] Hua Jun, Gu Chaolin, Zhuang Linde. The effect of foreign investment on regional economic growth[J]. *Economic Geography*, 2001, 21(6): 696-699.
- [29] Ning Yuemin. New process of urbanization: Dynamics and features of urbanization in China since 1990[J]. *Acta Geographica Sinica*, 1998, 53(5): 88-95.
- [30] Wang Lucang, Shi Peiji. Sustainable development of urban in the eastern fringe of the Tibetan Plateau[J]. *Journal of Glaciology and Geocryology*, 2002, 24(4): 457-462.
- [31] Xia Zonggan, Zhu Wenhua. Review and prospect of urban development and distribution in China[J]. *Urban Problems*, 1987, 6(1): 24-31.
- [32] Duan Hanming, Zhou Xiaohui, Su Min. The urbanization and spatial differentiation rule of Chinese northwest arid area[J]. *Advance in Earth Science*, 2004, 19(Suppl. 1): 407-411.
- [33] Li Chunhua, Zhang Xiaolei. Small urban construction and development in Xinjiang[J]. *Journal of Arid Land Resources and Environment*, 2002, 16(1): 55-61.
- [34] Li Ning, Gong Shijun. Ecological migration in Ningxia[J]. *Journal of Harbin Institute of Technology (Social Sciences Edition)*, 2003, 5(1): 19-24.
- [35] Jiang Ling, Pan Xiaoling. Influence of urbanization on Xinjiang oasis ecology environment and countermeasure[J]. *China Population, Resources and Environment*, 2005, 15(2): 69-74.
- [36] Long Aihua, Xu Zhongmin, Cheng Guodong, et al. Urbanization and sustainable countermeasures in Hexi Corridor oasis[J]. *China Population, Resources and Environment*, 2002, 12(5): 59-61.

- [37] Qiao Biao, Fang Chuanglin, Li Ming. Progress and prospect of study on interactive coercing process between urbanization and eco-environment in arid area[J]. *Progress in Geography*, 2005, 24(6): 31-41.
- [38] Liu Xuemin. Discussion on the effects and problems of ecological migration in northwest China[J]. *Chinese Rural Economy*, 2002(4): 47-52.
- [39] Sun Xinliang, Fang Chuanglin. Model and application of ecological risk appraisal in the course of urbanization in arid area[J]. *Arid Land Geography*, 2006, 29(5): 668-674.
- [40] Bao Chao, Fang Chuanglin. Comprehensive evaluation on urban environmental quality in arid area of northwest China based on matter element model[J]. *Arid Land Geography*, 2005, 28(5): 659-664.
- [41] Fang Chuanglin, Li Ming. Urbanization mode with the restraint of water resource in Hexi Corridor arid area of northwest China[J]. *Geographical Research*, 2004, 23(6): 825-832.
- [42] Jin Liya, Fu Jiaolan, Chen Fahu. Spatial differences of precipitation over northwest China during the last 44 years and its response to global warming[J]. *Scientia Geographica Sinica*, 2005, 25(5): 57-62.
- [43] Bao Chao, Fang Chuanglin. Temporal and spatial variations of water resources constraint intensity on urbanization in arid area[J]. *Acta Geographica Sinica*, 2008, 63(11): 1140-1150.
- [44] Maimaitiming Anwaer, Zhang Xiaolei, Yang Degang. Effects of urbanization on eco-environment in southern Xinjiang[J]. *Journal of Arid Land and Resources and Environment*, 2009, 23(12): 54-59.
- [45] Chen Ke. A study on XPCC' s new urbanization development and countermeasures[J]. *City Planning Review*, 2012, 36(7): 23-31.
- [46] Zhou Yubin, Chen Ke. A study of XPCC' s new urbanization and planning system construction[J]. *Urban Studies*, 2012, 19(5): 34-43.
- [47] Ni Chaojun, Zhao Xueran. Strategic significance and particularity of urbanization in Xinjiang Production and Construction Group[J]. *Chinese Journal of Agricultural Resources and Regional Planning*, 2012, 33(2): 88-92.
- [48] Liu Haixia. An analysis of social stability and Corps urbanization in Xinjiang[J]. *Journal of China Institute of Industrial Relations*, 2015, 29(1): 97-100.
- [49] Wang Li, Li Jiuquan. Quality evaluation and mechanism of capital city urbanization in northwest China based on new urbanization[J]. *Economic Geography*, 2014, 34(12): 55-61.
- [50] Maimaitiming Anwaer. Approach towards to further new type urbanization in Xinjiang[J]. *Journal of Xinjiang Normal University (Social Sciences)*, 2013, 34(6): 16-24.

- [51] Fang Chuanglin, Li Guangdong. Particularities, gradual patterns and countermeasures of new type urbanization in Tibet, China[J]. *Bulletin of Chinese Academy of Sciences*, 2015, 30(3): 294-305.
- [52] A Rong, Chen Cai, Dong Zhenhua. Evaluation of urbanization level in Inner Mongolia Autonomous Region[J]. *Journal of Arid Land Resources and Environment*, 2016, 30(10): 26-32.
- [53] Liu Jing, He Lunzhi. Quantitative analysis of new type urbanization driving factors and countermeasures in the core area of the Silk Road Economic Belt: Based on LASSO screening method[J]. *Arid Land Geography*, 2019, 42(6): 1478-1485.
- [54] He Yanbing, Huang Xiaojun, Zhai Lingxin, et al. Assessment and influencing factors of social vulnerability to rapid urbanization in urban fringe: A case study of Xi'an[J]. *Acta Geographica Sinica*, 2016, 71(8): 1315-1328.
- [55] Gao Zhigang, Hua Shuming. The mechanism and measurement analysis of the coupling coordinated development of new industrialization and new urbanization: Case study of Xinjiang[J]. *Forum on Science and Technology in China*, 2015(9): 121-126.
- [56] Li Junjie, Mi Wenbao, Song Yongyong, et al. Spatial-temporal differentiation and factors of urban-rural income gap in Ningxia[J]. *Research of Agricultural Modernization*, 2016, 37(4): 785-793.
- [57] Pang Liyuan, Ma Xiaoyu. Per capita income and its influencing factors in poor areas: A case study of southern Xinjiang, three ground state[J]. *Northwest Population Journal*, 2018, 39(1): 119-126.
- [58] Jia Yuantong, Cui Xiaoyong, Liu Yuexian, et al. Drought vulnerability assessment in Inner Mongolia[J]. *Acta Ecologica Sinica*, 2020, 40(24): 9070-9082.
- [59] Liang Bianbian, Shi Peiji, Zhou Wenxia, et al. Spatiotemporal pattern evolution of urbanization and water resources benefits in the Hexi Corridor[J]. *Arid Zone Research*, 2017, 34(2): 452-463.
- [60] Gao Xincui, Yang Fang. Measurement of coupling coordination degree between urbanization and ecological environment in northwest China[J]. *Urban Problems*, 2016(12): 26-33.
- [61] Zhu Haiqiang, Gong Lu, Zhao Jingjing, et al. Coupling relationship between urbanization and eco-environment in the core area of the Silk Road Economic Belt: A review[J]. *Acta Ecologica Sinica*, 2019, 39(14): 5149-5156.
- [62] Feng Xia. Coupling relationship between urbanization and ecological environment of Xinjiang[J]. *Areal Research and Development*, 2016, 35(3): 123-127.
- [63] Multitjiang Paziliyamu, Simayi Zibibula, Xie Yuan, et al. Study on the evaluation of regional spatio-temporal comparative analysis of coordinated development between urbanization and ecological environment in Xinjiang[J]. *Environmental Pollution & Control*, 2017, 39(9): 1043-1047.

- [64] Tang Zhiqiang, Qin Na. Coupling development of new type urbanization and ecological security in Zhangye City[J]. *Arid Land Geography*, 2020, 43(3): 786-795.
- [65] Yang Yongchun, Mu Yanjie, Zhang Wei. Basic conditions and core strategies of high-quality development in the Yellow River Basin[J]. *Resources Science*, 2020, 42(3): 409-423.
- [66] Song Yongyong, Xue Dongqian, Ma Beibei, et al. Urbanization process and its ecological environment response pattern on the Loess Plateau, China[J]. *Economic Geography*, 2020, 40(6): 174-184.
- [67] Zhang Xiaolei, Lei Jun, Duan Zuliang, et al. Prospect and 20-year retrospect of human-economic geography in Xinjiang, China[J]. *Economic Geography*, 2018, 38(4): 9-18.
- [68] Pan Jinghu, Liu Ying. Security-oriented transformation development in reclaiming and garrisoning areas: Case study of four cities in southern Xinjiang[J]. *Areal Research and Development*, 2016, 35(5): 67-71, 80.
- [69] Ma Wencan, Xu Zengrang. Settlements change and its influencing factors in pastoral area based on high resolution remote sensing image: A case study of Dangqu Watershed in Tibet[J]. *Economic Geography*, 2017, 37(6): 215-223.
- [70] Xu Xue, Ma Runping. Comprehensive measurement of new urbanization level and financial support in northwest ethnic areas: A case study of Ningxia Hui Autonomous Region[J]. *Modern Urban Research*, 2020(10): 75-80.
- [71] Lin Jinping, Lei Jun, Wu Shixin, et al. Spatial pattern and influencing factors of oasis rural settlements in Xinjiang, China[J]. *Geographical Research*, 2020, 39(5): 1182-1199.
- [72] Zhang Zilong, Chen Xingpeng, Lu Chengpeng, et al. Econometric analysis of the dynamic interaction between urbanization and economic growth and environmental pressure: The case of Ningxia[J]. *Journal of Natural Resources*, 2011, 26(1): 22-33.
- [73] Wang Changjian, Wang Fei, Zhang Xiaolei, et al. Quantitative analysis of the economic growth influence on urbanization and ecological environment pressure in Xinjiang[J]. *Journal of University of Chinese Academy of Sciences*, 2014, 31(2): 206-213.
- [74] Zhou Chunshan, Wang Yuqu, Xu Qiyong, et al. The new process of urbanization in the Pearl River Delta[J]. *Geographical Research*, 2019, 38(1): 45-63.
- [75] Liu Haimeng, Fang Chuanglin, Mao Hanying, et al. Mechanism of oasis urbanization: A theoretical framework based on complexity theory[J]. *Geographical Research*, 2016, 35(2): 242-255.

Note: Figure translations are in progress. See original paper for figures.

Source: ChinaXiv –Machine translation. Verify with original.