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# Sustainable future: A systematic review of city-region development in bay areas

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**Introduction:** Bay Areas are viewed as a complex region with integrated objectives and numerous functions. Despite the increasing interaction between bay area development and urban landscape transformation, the fragmented literature did not address the question: how to achieve sustainable development in the bay area? The objective of this study was to review the literature on four representative bay areas from both the West and the East, including the San Francisco Bay Area, New York Bay Area, Tokyo Bay Area, and Guangdong-Hong Kong-Macao Greater Bay Area. This study aimed to address the following two questions: What are the ongoing research trends in the field of bay areas? What are the most critical urban issues for future bay area development?

**Methods:** This study used a systematic review to examine publications from the Scopus database. Both descriptive and evaluative approaches were employed to analyze the publications on the four representative bay areas. The bibliometric analysis was performed using the VOS viewer to visualize research results and outcomes.

**Results:** The results revealed that the majority of the bay area related studies emphasized environmental issues, focused on decentralization and policy interactions, and the field of education received limited attention.

**Discussion:** This study contributes to the comprehensive understanding of the city-region development and provides policy suggestions for future sustainable bay area development. The findings of the keyword-based bibliometric analysis can be applied to other realms of city studies.

## KEYWORDS

urban sustainability, housing, transportation, infrastructure, health care

## 1. Introduction

Long-term national and regional development depends critically on fostering urban sustainability and integrating ecological, economic, and social benefits (Calzati et al., 2022; Zhang, 2022). The bay area, which is located along the coasts of a distinctive region with linked shores present in a certain area of the ocean or a harbor generated by continuous crustal movements, comprises more than half of the global population, economic activity and industrial capital (Gagné and Rasmussen, 2016). With the expansion of globalization and urbanization, bay areas have developed as typical urban agglomerations with distinct economic characteristics, notable metropolises, and port hubs with a high concentration and mobility of socio-economic resources (Takeuchi, 1998; Fang and Yu, 2017). They are significant urban agglomerations with high-level urbanization that serve as complex regions with integrated objectives and numerous functions (Kanai et al., 2018; Ma et al., 2021).

Urban studies and policy discourse have increasingly focused on the ideal “sustainable development” of bay areas in response to widespread global challenges, such as urban sprawl, informal settlements and climate change (Angelo and Wachsmuth, 2020; Li et al., 2021). Recent studies have revealed that the primary development strategy of bay areas has been the increase

in economic receptivity to the world (Zhang et al., 2022). Especially in the four representative bay areas, namely the San Francisco Bay Area (referred as SFBA), New York Bay Area (referred as NYBA), Tokyo Bay Area (referred as TBA), and Guangdong–Hong Kong–Macao Greater Bay Area (also referred as the Greater Bay Area or GBA), which have the highest economic production and population density. Moreover, the bay area's urbanization and metropolitan landscapes has also displayed considerable homogeneity as it has developed, including the expansion of the privatization of spaces that were previously under the public domain, the increase in the surveillance of public areas, and the establishment of modern theme parks (Cybriwsky, 1999; Bosselmann and Moos, 2014).

However, some scholars argued that due to variations in developmental prospects, choices, and management techniques, the bay areas have progressed along widely divergent developmental pathways (Yang et al., 2019). For instance, the well-designed public spaces in the Tokyo Bay Area have gradually transformed into “new urban deserts” compared to the New York Bay Area, which has effectively attracted people for leisure (Cybriwsky, 1999). Furthermore, government interference in bay areas developments and the results of public investment are not always positively correlated. The central regions of the bay areas of both Japan and the United States have experienced unequal growth, although the governmental strategies have considerably contributed to the situation in Japan, which differs from the market-oriented feature of the bay areas located in the United States (Jacobs, 2005). With the continuous establishment and expansion of bay areas globally, its developmental strategies have garnered increased practical and theoretical attention to the regional sustainability and the wellbeing of its inhabitants (Yu, 2021). Despite the persistent occurrence in economic, societal, environmental, technological, and political literature, studies on bay areas have various implications depending on what a researcher is looking for and overlook the systematic and thorough understanding (Su and Grydehøj, 2022).

The idea that city-regions are complex systems composed of interconnected components that might produce unexpected outcomes under state control and planning has grown in favor over the past decade among planners, designers, and politicians (Boelens, 2010; De Roo et al., 2012; Savini, 2016). Whereas, the self-organization theory continues to inspire ideas of an urbanism autonomous of the state, the debate on restructuring of linkages between urban-regional agencies and the state government are still ongoing (Uitermark, 2015). Meanwhile, the sustainable developments of metropolitans have decentralized and reshaped the urban landscape, giving rise to polycentrism in urban areas (Anderson, 2004; Van Meeteren et al., 2016). Hence, two conflicting voices of fragmentation and collaboration are present in the interaction of numerous local parties regarding who will have a crucial impact on the future development of city regions (Cheng and Shaw, 2021). The question of what kinds of region planning and interventionist policies are necessary to manage the escalating complexity of dynamic urban area development becomes essential in academia and practice.

The objective of this research was to systematically examine the characteristics of publications on “bay areas” to contribute to the debate of self-organization and polycentric development. This study, drawing upon the findings of Zhang et al. (2022), focused on the four representative bay areas in the world: San

Francisco Bay Area (SFBA), New York Bay Area (NYBA), Tokyo Bay Area (TBA), and Guangdong–Hong Kong–Macao Greater Bay Area (GBA). This study examined the peer-review publications related to the four representative bay areas by categorizing them according to publication years, countries, keywords, and themes. This study further analyzed the policy issues within city-region of selected bay areas, in order to provide future policy recommendations for emerging bay areas. By utilizing advanced analytical approaches, this study aimed to build a map based on bibliographic data and a systematic review to contribute to future urban sustainable developments.

## 2. Developing of representative bay areas

After World War II, the region around San Francisco developed rapidly, with much of the industrial growth occurring along the coast. However, people continued to relocate to the neighboring counties rather than living in the key cities of the bay area owing to the high cost of living in the region (Scott, 1985; Walker, 2009; Walker and Schafran, 2015). Consequently, commuters playing an essential role in the development of the urban agglomerations along the coast (Scott, 1985; Walker, 2009; Walker and Schafran, 2015). Relying on the attraction of the Silicon Valley, the counties around San Francisco amassed a high number of people and resources, culminating in the development of the early bay area in the world and a world-renowned harbor (Scott, 1985; Walker, 2009; Walker and Schafran, 2015). As shown in Table 1, there are around 7.8 million people living in San Francisco Bay Area, which has a GDP of US\$1.68 trillion in 2017.

The New York Bay Area is typically divided into two major parts: the Upper New York Bay and Lower New York Bay. As a center for finance, international trade, media and fashion, education and manufacturing, the NYBA is represented by four major cities with distinct features; New York as the financial and trading center, Washington, D.C. as the political center, Philadelphia as the industrial and transportation center and Boston as the technological and educational center (Shefter, 1993; Toz et al., 2016). The geographic location of NYBA closely resembles that of the New York metropolitan region as defined by the U.S. Office of Management and Budget, which primarily includes the New York–Newark–Jersey City region. Universities in the New York metropolitan area, such as Columbia University, Princeton University, Yale University, New York University and Rockefeller University, have cultivated a strong regional reputation (Toz et al., 2016; Hui et al., 2020). Therefore, taking into account the New York metropolitan area's significant contribution to the development of the New York Bay Area is critical for analyzing its development.

After the mid-nineteenth century, the Tokyo Bay Area also known as Greater Tokyo Area, was established with a manufacturing-based growth strategy guided by government policies and regulations, gradually building industrial clusters and zones with Tokyo being the major metropolis (Rose, 2017; Vasilyev et al., 2020; Song et al., 2022). Following a technical upgrade in the industrial economy in the 1960's, the Tokyo Bay Area developed an effective industrial-led development strategy based on advanced manufacturing, focusing on a knowledge-intensive economy with high-end services in information and communication technology (Rose, 2017; Vasilyev et al., 2020; Song et al., 2022). This escalated the TBA as one of the

TABLE 1 Socio-economic indicators of four bay area (2017).

	Greater Bay Area	San Francisco Bay Area	New York Bay Area	Tokyo Bay Area
Subregions/cities	11	8	9	6
Land area (million km <sup>2</sup> )	5.65	2.15	1.79	3.68
Population (million)	86.7	7.76	19.26	44.37
GDP (US\$ trillion)	1.60	1.68	0.78	1.86
GDP per capita (US\$ million)	2.36	8.34	10.16	4.23
Tertiary sector share (%)	77.6	89.4	82.8	82.3
Port container throughput (million TEU)	6,520	625	237	773
Airport passenger throughput (billion)	1.86	1.3	0.76	1.17
Global Financial Index Rankings	4 (Hong Kong)	2	8	5
Global Innovation Index Rankings	14 (Hong Kong)	4	4	16
Number of headquarters of the world's top 500 companies	21	29	24	60

Source: Subregions, land area, population, GDP, tertiary sector share, port container throughput, and airport passenger throughput come from Guangdong Statistical Yearbook, Association of Bay Area Governments, US Census Bureau, and Tokyo Statistical Yearbook. Global Financial Index Ranking comes from Global Financial Centers Index. Global Innovation Index Ranking comes from World Intellectual Property Organization. Number of headquarters of the world's top 500 companies are organized from Fortune magazine.

top economies in the Asia-Pacific region and the largest metropolitan area in the world, with accounted for more than 40% of the national GDP and population (Rose, 2017). Hence, this bay area has extended under the strong effects of globalization. This enormous city includes an array of city centers, some of which have independently developed city spaces within them.

In the twenty-first century, the Chinese authorities formulated a world-class city cluster called Guangdong-Hong Kong-Macao Greater Bay Area, which included 11 cities surrounding the Pearl River Delta (Luo and Lam, 2020; Huang et al., 2021). In March 2015, the National Development and Reform Commission, the Ministry of Foreign Affairs, and the Ministry of Commerce jointly released the document "One Belt, One Road," which introduced the idea of the "Greater Bay Area." In March 2017, the GBA initiatives was further incorporated into the "Report on the Work of the Government" by Chinese Premier Li Keqiang at the Fifth Session of the 12th National People's Congress. The Outline of the Plan for the Development of the Guangdong-Hong Kong-Macao Greater Bay Area was later announced by the Central Committee of the Communist Party of China and the State Council in February 2019. As the world's largest bay area, the Greater Bay Area has a total population of over 86 million and a GDP of US\$1,668.8 billion in 2022 (see Table 1). The GBA aimed to create an eco-friendly region regulated by the central government and the autonomy of the local states where technology, innovation and tourism were the key attractions (Luo and Lam, 2020; Bennett, 2021; Huang et al., 2021). By authorizing the flow of people, products, capital and information, the objective of the GBA was to achieve regional connectivity in the context of globalization (Hui et al., 2020; Luo and Lam, 2020; Mok, 2022).

As previously mentioned, a significant proportion of the regional and globalized economic, population, and land developments is attributed to key bay areas with an open economic structure, efficient resource allocation capabilities, powerful agglomeration, and advanced functions (Zhang et al., 2022; see also Figure 1 and Table 1). Moreover, developed international communication networks play a crucial role in leading innovation and agglomeration, thereby making these bay areas important growth poles driving

global socioeconomic development and leaders in technological changes (Cardoso and Meijers, 2017). Researchers have examined the independent evolution of bay areas on different continents primarily from an applied scientific perspective (Meléndez et al., 2015). However, few studies have examined and compared the development strategies of the four representative bay areas mentioned above. Along with de-globalization and polycentrism, the global health crisis has posed new challenges to extended urbanization and regional development (Connolly et al., 2021). Bay areas, as a frontier of human development, require a thorough investigation to provide insights into the adaptations to the changing environment and adjusting development strategy (Cowell, 2010). Therefore, evaluating the evolution of bay areas is important to determine the policies and activities highly likely to occur in a specialized region (Boschma, 2017). This study focused on the development and future of bay areas while going beyond simple geographic comparisons to provide a thorough systematic review of the published literature.

### 3. Materials and methods

To address the research questions using a systematic review supported by sufficient data, this study used both descriptive and evaluative approaches to analyze the publications on the four representative bay areas. Descriptive techniques were used to characterize the features of publications, including the number of publications by years, areas, countries or regions, and the co-occurrence of keywords. While these methods focused on unilateral and basic comparisons and determined the impact of publications, evaluative approaches to systematic analysis provided the exploration of various themes. Of the several bibliometric visualization tools available for determining a structural perspective of a research issue, the VOS viewer software, which includes numerous visualizing techniques, was used to acquire, analyze, and visualize bibliographic data in this study (Garfield, 2009; Van Eck and Waltman, 2017).



### 3.1. Data collection

In this study, we conducted a literature review of future developments in the bay areas, where peer-reviewed articles published before 28 June 2022 were analyzed. The Scopus database was adopted since all publications are evaluated on Scopus by an independent Content Selection and Advisory Board. Research keywords were employed to identify relevant publications. This study focused on articles on the four representative bay areas that were published in peer-reviewed journals. Meeting abstracts, articles from conference proceedings, books, trade journals, and reports were excluded from the analysis as they prevented an accurate evaluation of the development and prospects of the bay areas. To identify relevant articles, the following Boolean keyword combination was applied: TITLE-ABS-KEY (San AND Francisco AND Bay AND Area); (Guangdong–Hong AND Kong–Macao AND Greater AND Bay AND Area); (New AND York AND Bay AND Area) OR (New AND York AND Metropolitan AND Area); (Tokyo AND Bay AND Area) OR (Greater AND Tokyo AND Area). Furthermore, the publication collection only includes articles that were published in English considering the accessibility, readability, and representativeness.

### 3.2. Data cleaning and analysis

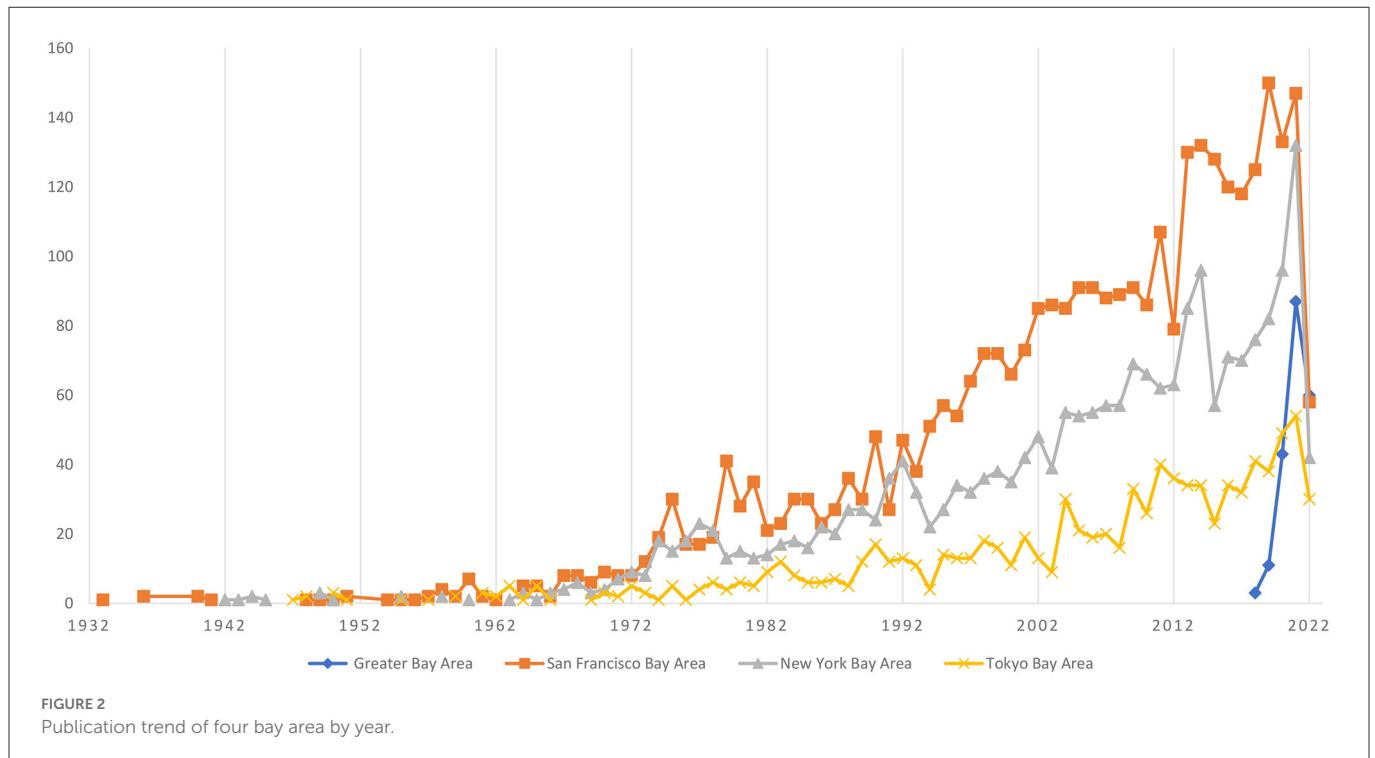
The abstracts and full texts of all publications were extensively investigated. Based on the exclusion criteria for the articles related to the bay areas, we selected 3,417 journal publications on the SFBA,

204 articles on the GBA, 2,193 studies on the NYBA or New York metropolitan area and 932 manuscripts on the TBA or Greater Tokyo Area. This study follows the progress of developing a comprehensive review of published literature. Following a bibliometric analysis, the most prominent study field “urban” was identified using the keyword co-occurrence analysis, which comprises the collective interconnection of terms based on their paired appearance within a certain unit of text. Thereafter, peer-reviewed publications in English related to the four long-standing bay areas that could influence policy-making for the developing bay areas were obtained by further specifying the Boolean keyword combination. The collated publications were then reviewed systematically using the content analysis technique.

## 4. Research trends in the field of bay areas

### 4.1. Bibliometric analysis of publication characteristics

The first article on bay areas, which focused on the SFBA, was published in 1933 and indicated the findings of several years of exploration into tidal and river-salinity movements of the water flowing into the Pacific Ocean through the Golden Gate (Means, 1933). A majority of the early studies focused on the environment and energy (Poland and Morrison, 1940; Caretto and Sawyer, 1972; Penner et al., 1983). The publications on the New York Bay Area and Tokyo Bay Area began to emerge and grow around 1950's (e.g.,



Edward and Rogers, 1950; Kimizuka, 1950). Overall, the number of publications focused on bay areas has been increasing since 2010 (see Figure 2). Furthermore, as the most recent bay area, the GBA was first investigated in 2018 (Haitao et al., 2018), and the number of publications has increased dramatically since then. Based on the publishing trend of the last 5 years, a few publications on the four representative bay areas might be available in the coming years.

Existing bay area research is unevenly distributed across multiple research areas. Most of the publications on the overall bay areas studies focus on geography and environment, followed by social sciences, with psychology perspective receiving the least attention (see Table 2). Moreover, the bay areas could be characterized based on academic interests; for instance, social science-based literature was increasingly available on the North American bay areas compared to the Asian bay areas. Most studies on the SFBA focused on science and engineering, whereas most studies on the NYBA focused on social sciences, followed by geography, environment and engineering. For the TBA, geography- and environment-based studies were prominent, followed by those on science and engineering. However, arts, humanities, psychology, and business administration were the focus of extremely few articles. No psychology-related studies have been published on the TBA. While the publications on the GBA focused on science and engineering, there have been no studies focusing on the arts and humanities aspects of the GBA.

In terms of the national and regional nature of publications, most of the research on bay areas was conducted at academic institutions located in the regions of the bay areas (see Table 3). In particular, Chinese researchers or higher education institutes primarily funded and published research on the GBA. In contrast, scientists and research centers in the United States primarily focused on the bay area within their territory, such as the NYBA and SFBA. Native scholars and academic organizations in Japan researched the TBA.

Additionally, we reported that the neighborhood affected the research on bay areas. The research on the bay areas in East Asia was seldom focused on by other countries. However, compared to other nations and regions, Canada and the United Kingdom have significantly more publications regarding the two US bay areas. Simply stated, Eastern and Western scholars are more concerned with their respective regional bay areas.

## 4.2. Keyword co-occurrence analysis

This study used author keywords as units of co-occurrence analysis, with the minimum number of occurrences of a keyword being five. We then consolidated and simplified the keywords based on the VOS viewer-filtered co-linear connections (Van Eck and Waltman, 2011; McAllister et al., 2021), generating the co-occurrence results for the keywords in the studies based on the four representative bay areas. The overall strength of the co-occurrence linkages with other keywords was calculated for each keyword, and the keywords with the maximum total link strength were presented by the bibliometric results.

Examining the keywords related to the SFBA revealed a fragmented clustering rather than addressing a core research concern. Only 27 of the 6,256 keywords in the co-occurrence analysis fulfilled the criterion. Risk study, which involves risk assessment, behavior and factor analysis, was the common theme in all topic clusters (see Figure 3). Within the San Francisco Bay Area, California was the primary theme of regional and municipal studies, with issues ranging from environmental protection of wetlands, estuaries and species to regional planning. Other focus areas of existing studies included health care and medicine development, particularly focusing on cancer, HIV, AIDS, and sexual behavior. Meanwhile,

TABLE 2 Publication major research area.

Subject area	Greater Bay Area	San Francisco Bay Area	New York Bay Area	Tokyo Bay Area
Social sciences	49	968	601	57
Medicine professions	39	1,107	44	18
Geography and environment	440	927	240	481
Science and engineering	175	1,125	110	190
Arts and humanities	0	241	29	8
Economics and business administration	72	195	10	9
Psychology	1	148	10	0

TABLE 3 Publication by countries/regions.

Main country/region	Greater Bay Area	San Francisco Bay Area	New York Bay Area	Tokyo Bay Area
China	189	36	37	37
Hong Kong	28	23	12	9
Macao	10	1	0	0
Australia	8	33	27	14
United States	8	2,937	1,825	98
United Kingdom	7	67	56	32
Japan	1	21	13	758
South Korea	2	16	12	13
Canada	2	78	69	11

health, immigration, and adaptability to the living environment were studied for distinct races and ethnicities. Recently, transgenders and the youth have become the focus of studies in these fields.

Although 52 out of 4,590 keywords achieved the threshold, only 50 keywords were selected from the NYBA visualization results as two keywords could not form any association with other keywords. New York City is seen as the center of research publications in the New York Bay or Metropolitan Area. Moreover, the keywords clusters of the SFBA and NYBA were similar as they both were located in the same nation (see Figure 4). The studies on the NYBA similarly focused on urban issues such as urban ecology, planning, and urbanization. Furthermore, scholars investigating the NYBA focused on immigration and health issues such as HIV, AIDS, alcoholism, and minority sexual behaviors. Metropolitan immigrant adaptability and social identity assimilation, particularly among Latin Americans, were the focal point of research on the NYBA. However, few ecological or environmental studies were undertaken on the NYBA as scientists have recently begun to investigate the effects of hurricanes on city lives.

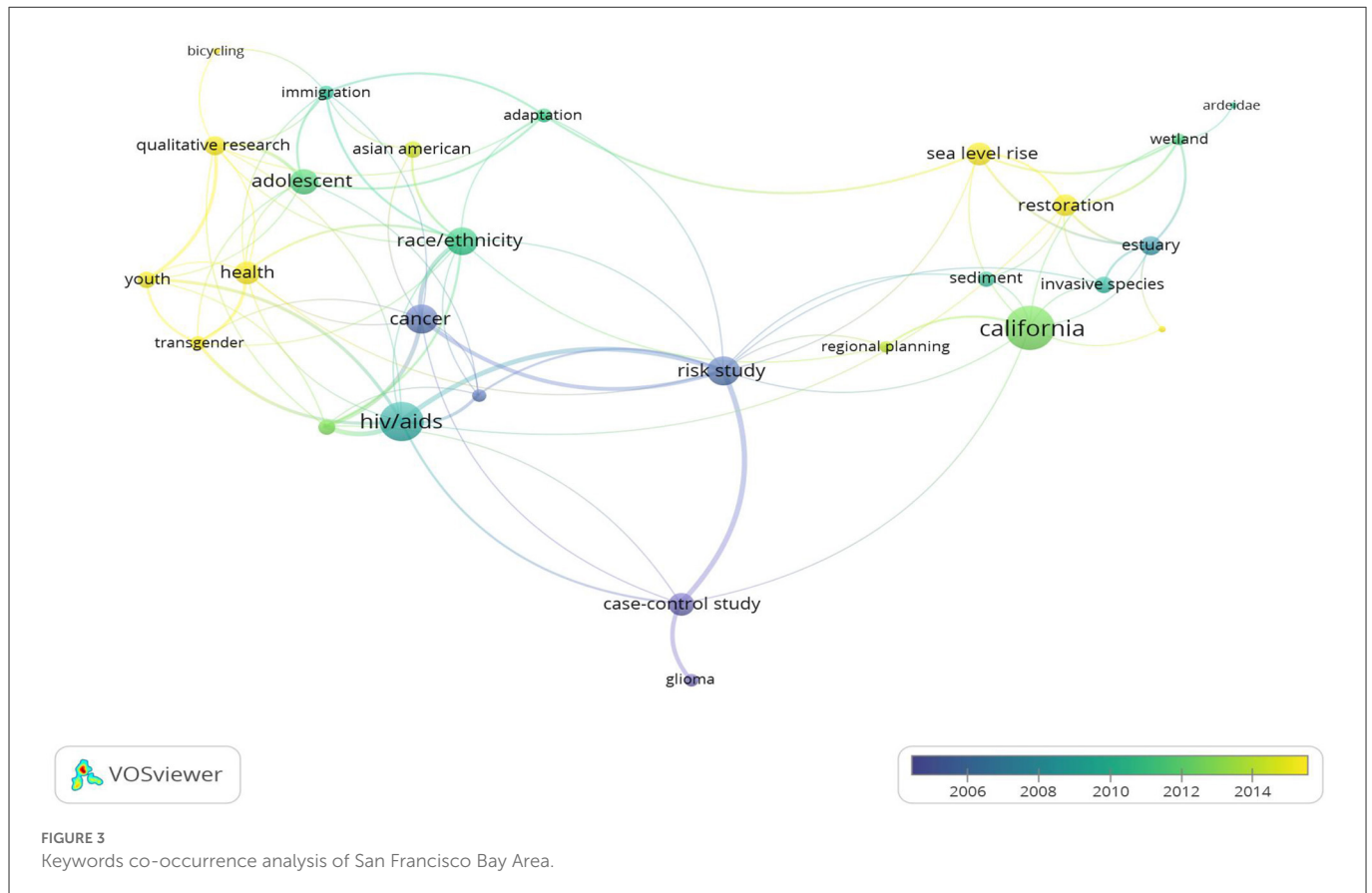
As the keyword clusters analyzed for the TBA or Greater Tokyo Area were weakly related to one another, we modified the minimum number of occurrences of a keyword to four for producing visualization results. Of the 2,475 keywords, 35 met the threshold. Early research on the TBA focused on plant hypoxia, sedimentation, estuaries, eutrophication and other biological and environmental issues (see Figure 5). Scholars focused on climate and catastrophes, such as earthquakes, tsunamis, climate change, and other natural disasters, over time. After 2018, publications on the TBA began to

focus on urban topics related to spatial distribution, COVID-19, remote sensing, and mental health.

While analyzing the publications on the GBA, 40 out of the 712 keywords exhibited linked outcomes. Urbanization was the most closely associated keyword with the studies on the GBA. In addition to focusing on the key cities of the GBA, the most prominent keywords were related to urban studies such as urbanization, urban expansion, and agglomeration (see Figure 6). Environmental aspects also attracted attention for studies on the GBA, which have increased over time. The management of the ecosystem and its associated services, as well as the integration of the green economy with technological innovation, were the primary environmental concerns.

## 5. Issues related to bay area urban development

Despite the expanding definition and geographical variances of the bay areas, the analysis of the aforementioned keyword demonstrated that the majority of the studies on the four bay areas extensively focused on urban issues. Therefore, we further restricted the literature search to “urban” and the three long-established bay areas as the keywords, to implement the findings for future development of, and policy implementation in, the emerging bay areas such as the GBA. To identify relevant articles, the following Boolean keyword combinations were applied: [TITLE-ABS-KEY (San AND Francisco AND Bay AND Area) OR TITLE-ABS-KEY (New AND York AND Bay AND Area) OR TITLE-ABS-KEY (New



AND York AND Metropolitan AND Area) OR TITLE-ABS-KEY (Tokyo AND Bay AND Area) OR TITLE-ABS-KEY (Greater AND Tokyo AND Area) AND TITLE-ABS-KEY (urban)].

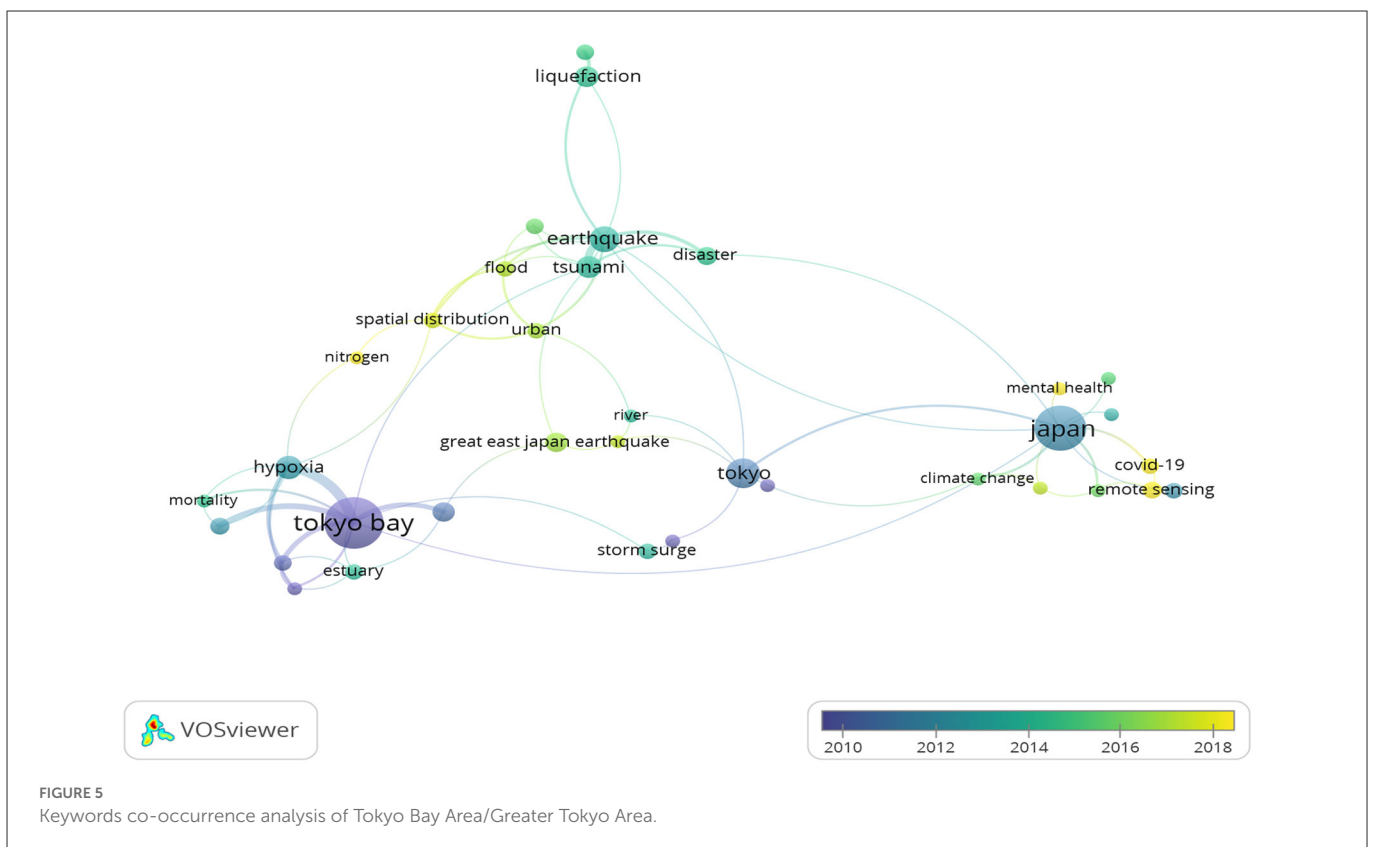
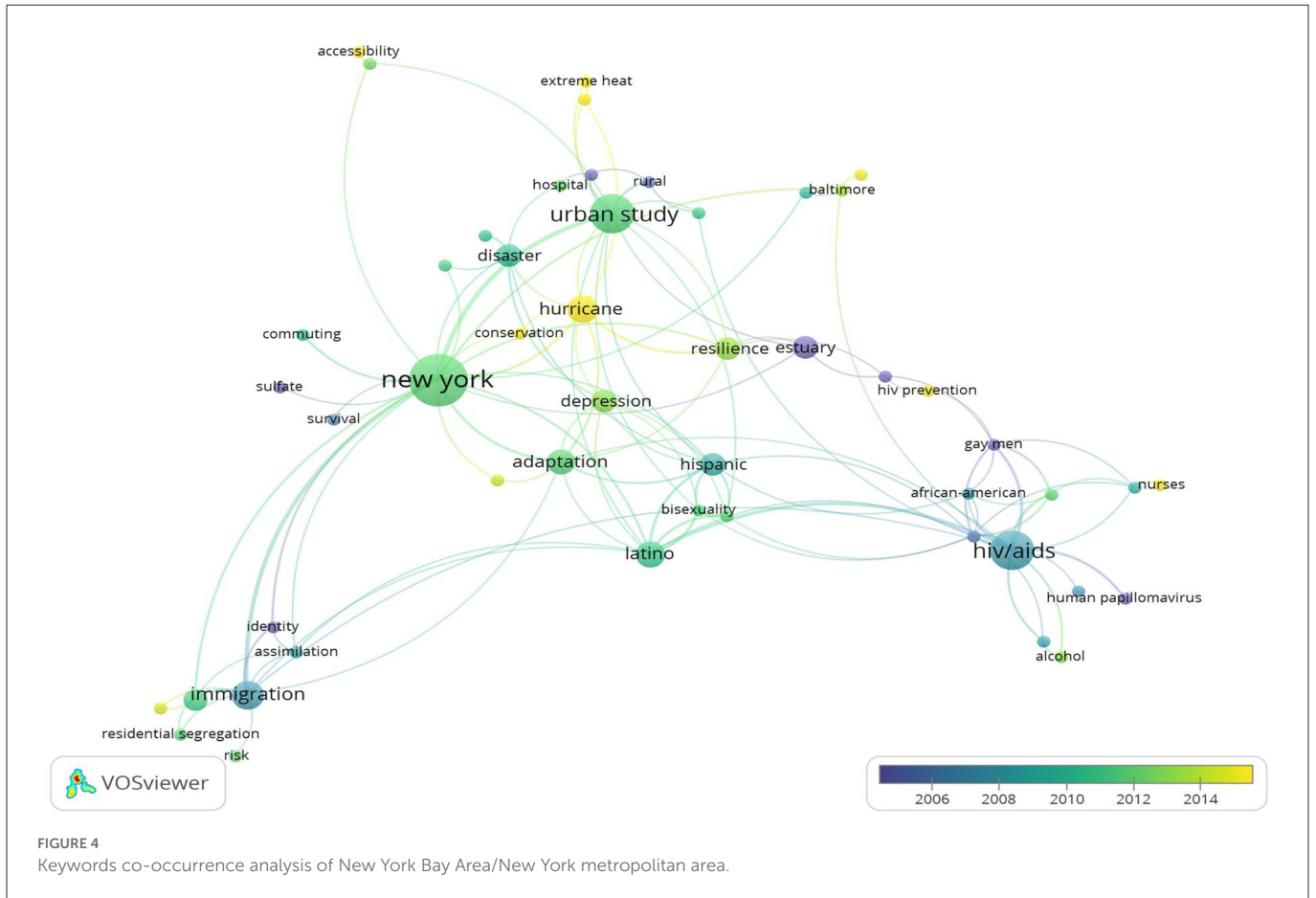
We then filtered the 1,280 articles in English from peer-reviewed journals and used 1,082 publications for content analysis. By analyzing the complete text of the selected articles, we summarized the publications that may help in policy implementation for the development of emerging bay areas. As the technical arguments in applied science publications related to bay areas exhibited reduced linkage with policy and urban development (e.g., Miyake et al., 1961; Sandberg et al., 1970; Mito et al., 2021; Arnold, 2022), we excluded studies on the environmental and ecosystem aspects of the bay areas. Therefore, based on the systematic review, four areas were identified for policy implementation—housing, healthcare, urban infrastructure, and transportation.

## 5.1. Housing

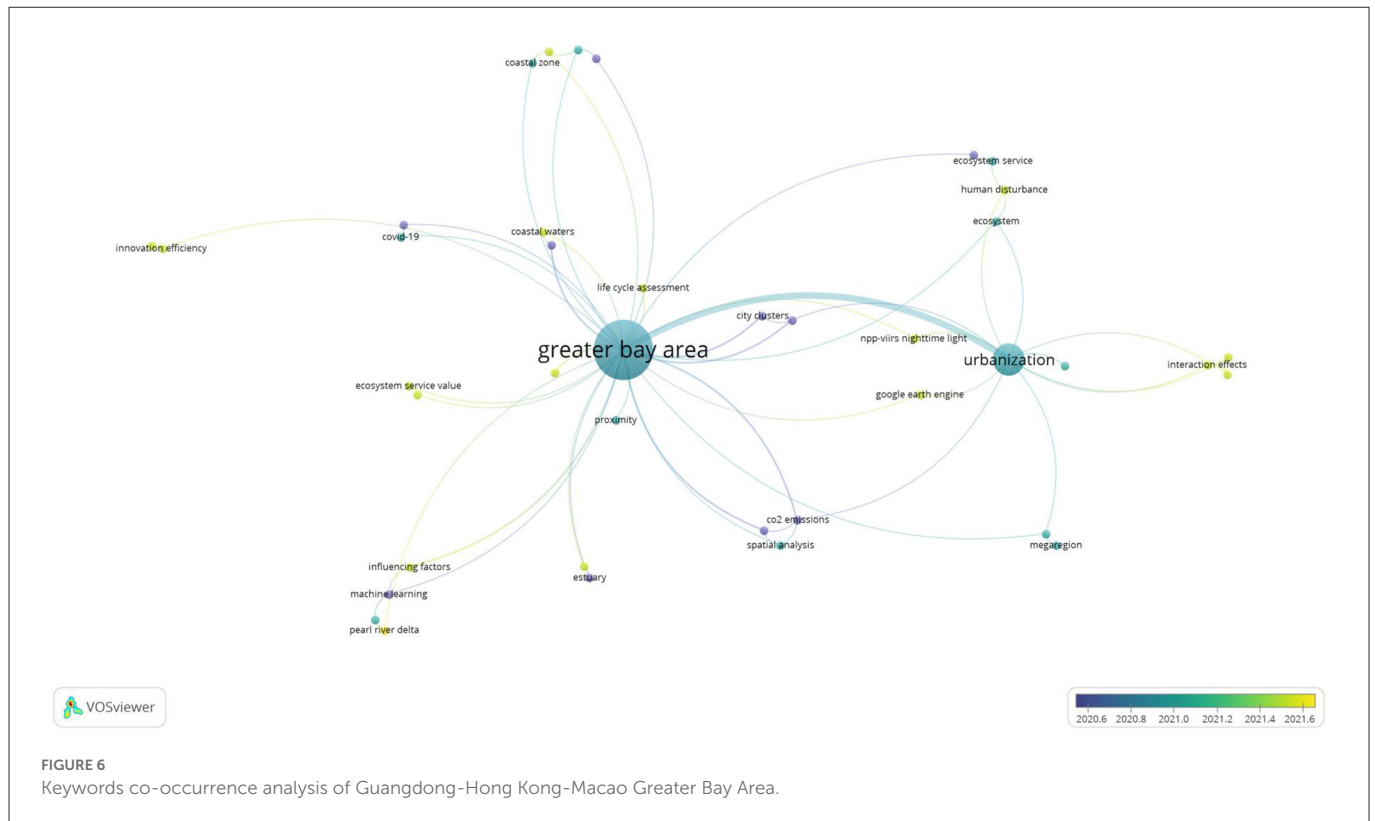
Housing issues have been linked to poverty in most studies (Holland et al., 1995; Barton, 2011; Botein, 2016). Additionally, few scholars have suggested that housing is a vital step in urban life as it directly affects the employment, marriage and education prospects of an individual (Benediktsson, 2018; Le Galès and Pierson, 2019). Consequently, previous studies have emphasized the displacement impact of housing policies, which might result in a rise in socioeconomic disparity and other social problems in the latter developmental stages of bay areas (Nagashima, 1972; Nguyen, 2022).

Despite the controversy over whether policy or geography is responsible for the high rent and housing costs in the bay areas, studies on bay areas aim to find solutions and policies to address urban gentrification and renewal, the suburbanization of underprivileged groups and other housing inequities. Early studies on housing in bay areas have focused mostly on determining solutions to the rising living standards and land-use transformation for the disadvantaged and working-class populations. In contrast, communities aim to preserve their properties. Nagashima (1972) investigated how farmers in the suburbs of the TBA protected themselves from bankruptcy by transforming agricultural land into apartment buildings throughout the urbanization process. However, Holland et al. (1995) proposed the development of service coordinator positions supported by the Department of Housing and Urban Development for delivering services to older people living in the SFBA. As the number of immigrants and minorities in the United States increases significantly in recent decades, studies gradually concentrate on immigration and minority groups in the SFBA and NYBA (Botein, 2016). In contrast to the conventional forms of housing inequality and segregation, this new geographical marginalization crisis is closely related to labor productivity, employment opportunities, health status, and living conditions, all of which urgently require government intervention through public policies (Cervero, 2001; Howard, 2013).

Furthermore, researchers who have studied the two United States bay areas recommended a multi-sectoral partnership between the market, private sector, and local government for housing support and community investments (Barton, 2011; Garzón et al., 2014;







Rosenman, 2019). Related studies emphasize the critical role of non-profit organizations and the market in reducing housing inequities and improving the living conditions of various communities. Barton (2011) proposed that the government need to fund non-profit housing organizations, particularly land trusts, to withdraw residential land from the market. Both Garzón et al. (2014) and Rosenman (2019) suggested designing social investment strategies to assist underprivileged tenants considering the perspective of private investors and other advocates. Moreover, the study by Snyder et al. (2014) on informal settlements revealed that the government must consider the variations across and within the housing while developing housing strategies.

## 5.2. Transportation

Transportation and its economic implications in the bay areas require increased academic attention as manufacturing employment has been transferred to the service sectors and this process in bay areas is no exception (Wong et al., 2020). The changes in employment accessibility, to some extent, indicate the degree to which land use and transportation bridge the gap between work possibilities and labor forces. According to Cervero et al. (1999), the policy decisions on resource allocation in the urban transportation sector assist in addressing disparities in employment, medical facilities and other fields.

For decades, the practical developments in the bay areas have encouraged that public transportation networks, particularly rail systems, must be included in urban development. In the polycentric SFBA, the Bay Area Rapid Transit system (BART) has been a

remarkably efficient transportation system that improved freeway-oriented suburban employment growth (Faulkner et al., 2016). If the bay area originally aimed to achieve a compact, multi-centered urban agglomeration, Cervero and Landis (1997) suggested that public policy interventions, including financial incentives and land assembly assistance, would be required to support the regional expansion of public transportation. However, in addition to boosting the economy and employment, an effective transportation infrastructure does not always lead to socially sustainable development. Winston and Maheshri (2007) assessed the contribution of each urban rail operation of the United States for social welfare based on the demand for, and cost of, their services and revealed that every railway programme except the BART in the SFBA altered welfare of the people.

Literature on bay areas has concentrated on identifying effective transportation network designs within the region owing to their significant linkages to employment, housing, transportation, and economic growth. Four strategies used by the Metropolitan Transportation Commission of the SFBA were recognized by Innes and Gruber (2005) as technical or bureaucratic, political, social, and collaborative. However, policymakers who incorporated one method were usually distrustful of those using another as they exhibited different assumptions of knowledge and nature. Accordingly, it is suggested that collaboration is the most effective approach for locations with a high diversity of interests and interconnection of actors (Innes and Gruber, 2005). Nevertheless, financial requirements and documentation required by the state and federal regulations are significant barriers to regional collaboration in bay areas (Innes and Gruber, 2005). Hence, Heyer et al. (2020) emphasized the issue of suburban neighborhoods in the SFBA being relatively disconnected from the public transportation systems serving the urban core and

suggested the development of non-discriminatory transportation and uniform distribution of investment funds.

### 5.3. Infrastructure

Urban planning and infrastructure in bay areas have garnered increased scholarly attention as an indicator of metropolitan development. Inappropriate urban planning and infrastructure development may contribute to the fragmentation of metropolitan areas through the unequal distribution of resources within the bay areas (Dilworth, 2002). However, urban development is not a standard process as ideological advancement and policy orientations alter planning and infrastructure. In the SFBA, for instance, urban planning progressed from the city-beautiful ideals in the 1890's to the city-functional objectives in the 1920's, effectively attracting talent and tourists into the bay area (Rodriguez, 2000).

On the one hand, one of the most urgent research problems in studies on bay areas is the interaction between ecological systems and human-induced infrastructure. Regional environmental governance and urban planning must necessarily involve several public actors. At the end of the last century, scholars indicated the following two important issues by analyzing the development of edge cities in the SFBA: a shift in public planning from a traditional regulatory role to collaborations with developers, and uncoordinated development of edge cities under the state-mandated and locally implemented urban plans (McGovern, 1998). Pinto et al. (2018) further emphasized how departmental collaboration could not appropriately transition from the Center-led policies to local adaptive governance. In this regard, Harris-Lovett et al. (2018) presented a new paradigm of urban infrastructure for stakeholders to proactively establish cooperative connections based on common objectives and develop new norms to address the restrictions of the existing political systems. Additionally, public-private partnership (PPP) and private finance initiative (PFI) have been proposed for urban infrastructure in the TBA by Japanese scholars (Harada, 2017).

In contrast, few scholars suggested that policies must be developed considering the population of the bay areas and their interests. Studies by Kitamura et al. (1997) and Gainsborough (2002) have highlighted the importance of the perspectives of the residents for the success of urban policy and plan implementation in bay areas. Furthermore, Lehning (2014) emphasized the necessity of supporting older residents in bay areas. In addition to individual perspectives, scholars have also focused on the relationships between social interaction and urban infrastructure in bay areas. Urban parklands provide a crucial setting for cultural ecosystem services and strengthen social resilience (Campbell et al., 2016). Perry et al. (2018) further highlighted the importance of "parknerships" (park partnerships) to combine the strengths of national organizations concerned with local relevance and social partners.

### 5.4. Healthcare

Although early studies on bay areas examined geographical and ethnic variations in health and disease treatment, ongoing research is increasingly focused on healthcare because of the occurrence

of pandemics (Lott et al., 2022; Sakuma et al., 2022). Health-related research on bay areas has consistently developed with time, from early studies focusing on the accessibility of preliminary and physical healthcare services to the latest research focusing on specific population groups and psychological issues. Early studies on NYBA highlighted the trends in suburbanization of medical services and advocated a centralized data system to improve the accessibility of patient information to all emergency community-care centers, for the rapid identification of refractory patients and improve acute episode treatment (Karetzky, 1977; Miller et al., 1978). Following the pandemic in 2020, healthcare-based studies on bay areas transitioned from the medical profession with a specific group orientation to engaging technology with family as a research unit (Mendez et al., 2021; Lott et al., 2022).

In addition to concerns about the prevalent health issues (Gorey and Vena, 1995), including obesity, cancer and depression, healthcare research increasingly focuses on specific demographics, such as urban students of color (Yeh et al., 2022), Latin-American families (Mendez et al., 2021), marginalized individuals (Shedlin et al., 2006), and families with special needs (Shedlin et al., 2006), in the bay areas located in the United States. However, the majority of healthcare research primarily focuses on disease treatment and technical support to disadvantaged populations to enhance access to healthcare services (Xia et al., 2019; Mendez et al., 2021), but issues related to healthcare policies receive limited attention and few studies indicated the reduced viability of finance and human capital for providing these services.

## 6. Policy implementation and recommendations

The housing, transportation, infrastructure, and health care are identified in this study as the four major urban concerns in the bay area development process. Despite the fact that each of the four areas is crucial to people's livelihoods and wellbeing, recent bay area-related studies emphasize more on economic development than social inclusion and welfare. While the Western bay areas are more focused on the underprivileged group living conditions, the Eastern bay areas are more worried about the effects of the environment and land use on its development. Among the sustainable development goals proposed by the United Nations, urban development concerns in various bay areas revealed different preferences. Racial violence (Tagle, 2019) and social exclusion of ethnic minorities (Meyer and Keenan, 2018) are the common concerns of studies on the SFBA. Studies on the TBA emphasize water resource management and measure to tackle natural catastrophes such as earthquakes and typhoons (Harada, 2017).

Decentralization in the land-use, transportation, and economic sectors, according to several publications, would facilitate the bay area's future growth and expansion. Similar to other metropolitan agglomerations, the bay areas demonstrated a self-organization character beyond national planning. Existing literature has emphasized the significance of establishing a balance between public interest, governmental constraints, and private sector interests. Meanwhile, several studies on bay areas emphasize the interaction between social policies such as the strong relationship between healthcare services, commercial establishments, labor employment, and travel attraction (Althobaiti et al., 2021). However,

few publications discuss bay area development from an educational perspective. The extant findings and discussions related to education in metropolitan cities of the NYBA (Fazio and Rossi, 1991) and the issues of private school education indicated by Wrigley (1999), must be updated with the current educational trends.

Moreover, growing numbers of publications in the Greater Bay Area are focusing more on education, as the sustainable policy strategies view education as social capital for young people to pursue a better life and social mobility (Tang, 2020; Liu, 2021; Xie et al., 2021; Baur, 2022; Mok, 2022; Zhu and Mok, 2022). With the influence of the transition in lifestyle on remote working and learning during the COVID-19 pandemic (Connolly et al., 2021; Yeh et al., 2022), it is crucial to consider whether the functions of the bay areas as an urban agglomeration of labor and consumer groups have to shift their focus from the development of materialistic infrastructure to the provision of extensive social services, such as quality education for underprivileged individuals. Additionally, as the literature noted, edge cities are expanding in most bay areas, demanding extra state assistance to maintain respectable living conditions for the residents who are left behind by the center cities.

The significance of promoting effective integration of environmental, economic, and social considerations in multilateral systems is emphasized by the Sustainable Development Goals. Policies specifically aimed at ensuring stable economic growth, a health environment, or inclusive social development. Learned from existing studies, we could offer policy recommendations for the bay area's future development in terms of improving the government decision-making process and including non-governmental participants in policy implementation. Furthermore, new climate-related impacts, war immigration, and the development of diverse education require governments, corporations, non-government organizations, and citizens taking an active role in bay area sustainable development. Academics should actively follow ongoing research and propose innovative perspectives on bay area-related studies.

## 7. Conclusions

This study improves the systematic understanding of global bay-area dynamics and suggests further research on, and policy development in, emerging bay areas and their context-dependent development. Although this review offers an opportunity to learn

more about the development of bay area research, the conclusions cannot be generalized. Beyond the four representative bay areas included for this study, other bay areas may experience the same or a different developmental trend. The findings of the keyword-based bibliometric analysis can be applied to other realms of city studies, and additional lessons can be learned from increasingly broad reviews of studies conducted worldwide to improve the understanding of the sustainable urban development in the bay areas. Additionally, further investigations are necessary to include studies published in non-English languages, particularly regional native languages, to provide a holistic perspective on development in bay areas.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## Author contributions

ZT contributed to conception and design of the study, performed the statistical analysis. ZT and BZ organized the database. ZT wrote the first draft and completed all sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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