

Description to the Historical Records Dataset on Human Activity in the Hexi Corridor of China (from Neolithic to Qing Dynasty)

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Abstract: Social responses to environmental change over human history have generated extensive debate among researchers. Comprehensive human activity databases are valuable for exploring the links between human evolution and environmental change. The Hexi Corridor is a crucial area where eastern and western civilizations met due to its location in the eastern section of the ancient Silk Road. Here, we present a comprehensive dataset of the Hexi Corridor, including disasters, population, wars, famines, and settlements from the Neolithic to the Qing dynasty. These data are mainly from various digitized historical sources, which have been extracted, digitized, and georeferenced through a standardized process. The ultimate aim of these data is to provide as comprehensive a record as possible of human activity in the Hexi Corridor to support ongoing research on human-environment relations.

Keywords: Hexi Corridor; human activities; disasters; ancient sites

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Dataset Availability Statement:

The dataset supporting this paper was published and is accessible through the *Digital Journal of Global Change Data Repository* at: <https://doi.org/10.3974/geodb.2023.07.09.V1> or <https://cstr.escience.org.cn/CSTR:20146.11.2023.07.09.V1>.

1 Introduction

It is undoubtedly a serious challenge to modern societies' political and economic development rate than ever before^[1, 2]. Over the past tens of thousands of years, human has gone from being dependent on nature to using nature try to try to develop in harmony with nature, culminating in the present civilization^[3, 4]. Over the past century, research on environmental change has been mainly concerned with the natural sciences^[5, 6]. As research continues, scientists are finding it increasingly impossible to ignore the impact of human

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[2] Gao, M. J., Li, Y. Historical records dataset on human activity in the Hexi Corridor of China (from Neolithic to Qing Dynasty) [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2023. <https://doi.org/10.3974/geodb.2023.07.09.V1>. <https://cstr.escience.org.cn/CSTR:20146.11.2023.07.09.V1>.

activity. Using human activity as a thread provides a new perspective on the relationship between environmental change and human activity in the research on the relationship between human origins, agricultural origins, civilizational origins, social development, and climatic and environmental changes^[7–10]. These research directions have been implemented and advanced with increasing emphasis on the impact of human society on global environmental change and the issue of human society's response and adaptation to global change. The volume of this work and its evolving scientific understanding generate organizational challenges associated with data collection, extraction, validation, and application.

The spatial and temporal integration of human data involves the spatial differentiation of complex human activities, and many theoretical and technical problems need to be overcome, including the spatial distribution of human data, theoretical and methodological research related to data sampling, and results testing^[11]. Compared with natural environmental data, human data are mainly based on human units rather than natural units in terms of spatial units. This poses problems, such as difficulty identifying dates, low spatial resolution, differences in dating methods, and changes in administrative boundaries^[12].

The Hexi Corridor is a typical area of synergistic influence of the mid-latitude westerly circulation and the Asian monsoon and is a sensitive area for environmental change^[13]. It is located at the throat of the Silk Road. It is an important route for the spread of prehistoric humanity and cultural exchanges between East and West, as well as a meeting point for the evolution of civilizations in Eurasia and a frontier for the clash between Chinese agricultural and nomadic civilizations^[14,15]. Finally, considering that the Hexi Corridor is the main oasis agricultural and landscape distribution area in China and worldwide, with significant changes in water resources and fragile oasis ecosystems, together with the currently hotly debated warming and humidification of the Northwest and climate hazards, the region is an area of concern for future climate change^[16].

Here, we present a new database of Holocene paleoclimate human and historical records from the Hexi Corridor and the adjacent region. This database is composed of records from individual sample studies and records that are compiled by previous summaries. This database includes disasters, population, wars, famines, and settlement records that reflect human activities. All data is published in .xlsx format. This geographically distributed collection of human activity data records integrates environmental change as well as human activity characteristics in the Hexi Corridor region, forming a network from which to assess the spatial and temporal variability of regional climate change and human activity.

2 Metadata of the Dataset

The metadata of the Historical records dataset on human activity in the Hexi Corridor of China (from Neolithic to Qing dynasty) is summarized in Table 1^[17].

3 Methods

3.1 Data Collection and Data Extraction

Human activity data are considered for inclusion in the regional environmental change database. Human history data is obtained from a wide range of historical sources in China, including various historical sources such as general histories, ancient maps, annals, and modern secondary statistics such as government releases, books, modern maps, and some recent research papers. This dataset is intended to extract data on the humanities of Gansu province from the Neolithic period to the Qing dynasty, including ancient sites, ancient cities, disasters, wars, population, and famine. The processing of the primary data is broken down

into the following categories.

(1) War

This chronology is based on the chronology of the wars that took place in China from the legendary Shennong era in the 30th century BC to the end of the Qing dynasty in 1911 and provides a brief account of the causes, course, outcome, and characteristics of the significant

Table 1 Metadata summary of the digital database of human activity in the Hexi Corridor^[17]

Items	Description
Dataset full name	Historical records dataset on human activity in the Hexi Corridor of China (from Neolithic to Qing dynasty)
Dataset short name	HexiCorridorHumanActivity
Authors	Gao, M. J. HTR-7743-2023, College of Earth and Environmental Sciences, Center for Hydrologic Cycle and Water Resources in Arid Region, Lanzhou University gaomj21@lzu.edu.cn Li, Y., Key Laboratory of Western China's Environmental Systems (Ministry of Education); College of Earth and Environmental Sciences, Center for Hydrologic Cycle and Water Resources in Arid Region, Lanzhou University, liyu@lzu.edu.cn
Geographical region	the Hexi Corridor
Year	4000 BC–1900 CE
Spatial resolution	City and county
Data format	.xlsx, .shp
Data size	1.78 MB
Data files	3 datasheets: ancient city and ancient ruins (including .shp), disaster and famine; wars
Foundations	National Natural Science Foundation of China (42077415); Ministry of Science and Technology of P. R. China (2019QZKK0202, BP0618001)
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	Data from the Global Change Research Data Publishing & Repository includes metadata, datasets (in the <i>Digital Journal of Global Change Data Repository</i>), and publications (in the <i>Journal of Global Change Data & Discovery</i>). Data sharing policy includes: (1) Data are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use Data subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute Data subject to written permission from the GCdataPR Editorial Office and the issuance of a Data redistribution license; and (4) If Data are used to compile new datasets, the 'ten per cent principal' should be followed such that Data records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset ^[18]
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS/ISC, GEOSS

wars^[19]. Due to the subjective nature of the records, we have not compiled statistics on the number of casualties of the wars but merely extracted the time, place, and type of warfare. For the time of the war, the imperial chronology was converted into the A.D. chronology by comparing it with the ancient Chinese chronology. For the location of the war, it has been converted into a modern location according to Chinese Historical Atlas^[20]. We examined the causes of the wars and divided them into rebellious wars and other wars^[20].

(2) Disaster and famine

The main source of disaster information is the History of Disasters in Northwest China, a systematic summary of the history of disasters in the Northwest of China based on hundreds of credible historical documents^[21]. and we have also collected documents published in journals and searched the original records to check them all and fill in the gaps to reflect the historical climate more objectively^[22–25]. As historical sources are sometimes lost after being collated several times, we still consider them reliable but do not mark them as such.

(3) Population

As in modern societies, population counts are not conducted annually, and often, feudal rulers would only conduct a census once during their reign, so the population numbers obtained through historical sources often vary in time intervals. In order to provide a more

comprehensive picture of the demographic trends in the Hexi Corridor, we have collected the current continuous demographic studies and, using mathematical methods based on previous studies, have calculated the population numbers at 50-year intervals^[26–28].

(4) Ancient sites and an cities

The ancient sites and cities' statistics are based on the Atlas of Chinese Cultural Relics-Fascicule of Gansu province. The coordinates are given using the spatial alignment function of ArcGIS to obtain the coordinates of the spatial location of the protected units and export them to Excel. The coordinates of the ancient cities are calibrated with the help of Google Maps. The chronology of the ancient city is calibrated according to the descriptions in the atlas and combined with archaeological data.

Other human and paleoclimatic records are considered but ultimately excluded because they did not meet the selection criteria. Most of the excluded records are either not sufficiently clear in their description of human activity, e.g., lacking information on elements such as time and place not credible sources; some wild histories and documents processed several times lack a clear relationship between proxies and climate, of insufficient duration or poor regional representation, and not meeting the sampling resolution criteria.

3.2 Technical Workflow

The reconstruction process of human activity data mainly included (1) Extracting different types of anthropogenic data from historical sources, and (2) Generating tables and drawing diagrams of anthropogenic data. Figure 1 shows the workflow for extracting different types of human activity data.

4 Data Results and Analysis

Figure 2 shows the statistical curves for changes in disasters and famines. We collect and collate data on 1,085 disasters and information on 238 famines. Droughts and floods are the main types of disasters in the Hexi Corridor, with the sum of the two accounting for almost half of the disasters in the Hexi Corridor (Figure 2b). In terms of rank, mild and moderate disasters make up the majority (Figure 2a). Based on spatial data, the distribution of disasters in the Hexi Corridor is relatively even, with no prominent most challenging hit areas (Figure 2c). The Ming and Qing dynasties (1368 AD–1912 CE) appear to have been a period of high disaster occurrence, as indicated by the curve of disasters over time, but this may be because more historical material has survived from that period (Figure 2d).

Figure 3 shows the distribution of ancient sites and cities from the Neolithic period to the Qing dynasty. Of the 2,077 site points information collected and collated, there are 2005 ancient site points and 72 ancient burial sites. According to the spatial distribution characteristics, in the early Neolithic period, the site points of the Majiayao culture were mainly distributed in the eastern part of the corridor. In contrast, the Qijia culture continued to expand to the east and is more concentrated (Figure 3ab). The Qijia culture is followed by a period of richness in ancient cultural types in the Hexi Corridor, and these cultures begin to migrate to the western part of the corridor. The early sites are distributed on the highlands according to the DEM features. However, as the culture developed and the distribution of sites diversified, they also began to move downstream towards the rivers, seemingly due to increased topographic adaptation (Figure 3c). The reasons for this phenomenon may be multifaceted and are a matter for further research. The ancient cities of the Hexi Corridor have been built and abandoned many times throughout the historical period (Figure 3d). The Silk Road is the central vein of distribution of the ancient cities, and almost all of them were built along the Silk Road. During the Qin-North and South dynasties, the distribution of ancient cities was loose, basically scattered along the Han Great Wall. From the Song-Yuan period onwards, the focus of the distribution of ancient cities began to be within the Ming Great Wall, and most of them fell into disuse. The Ming and Qing dynasties are the period with the

largest number of ancient cities in the Western Corridor, possibly due to the development of the rulers and the short period that has passed since then, making them easy to preserve.

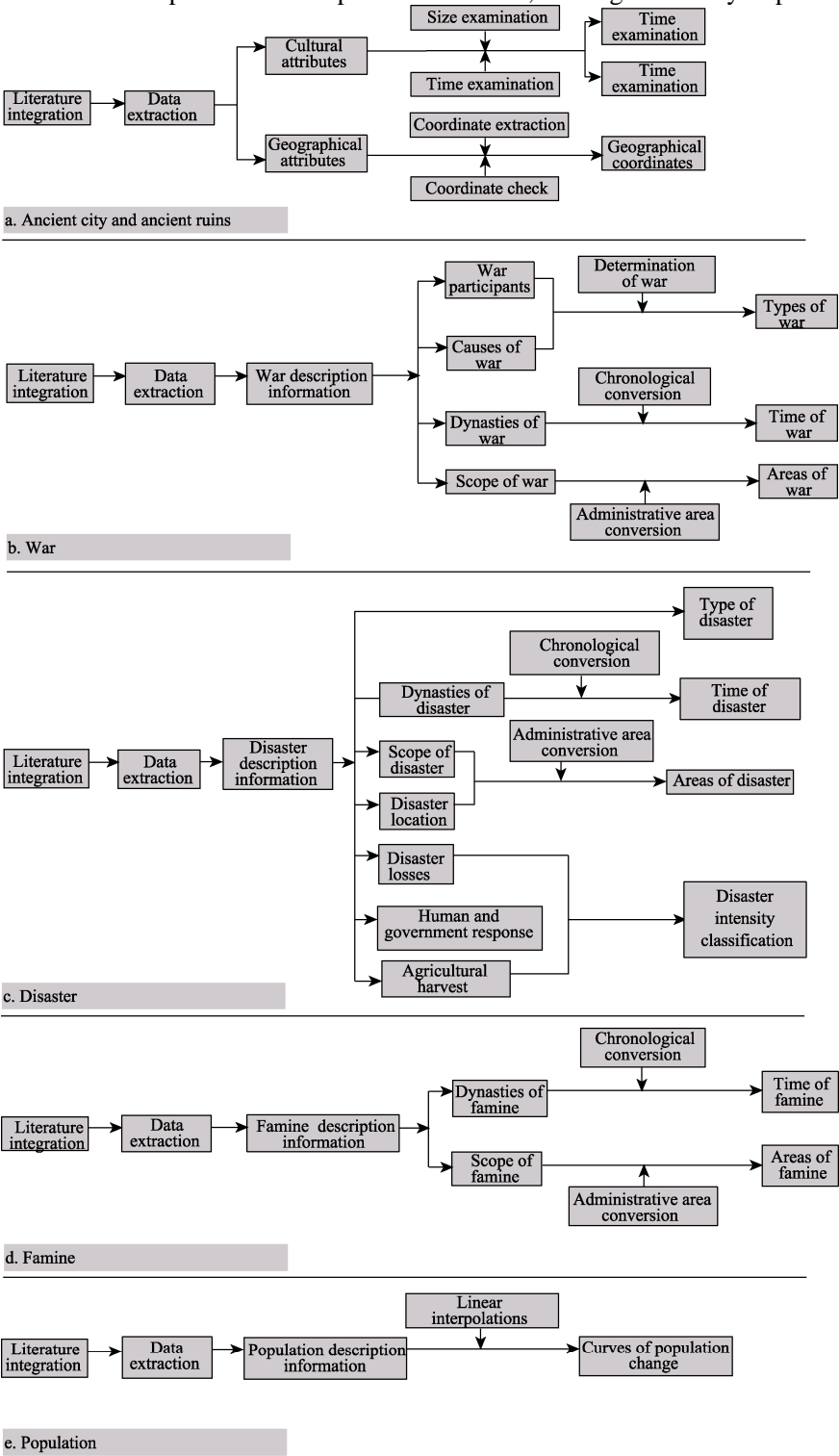


Figure 1 Workflow for extracting different types of human activity data

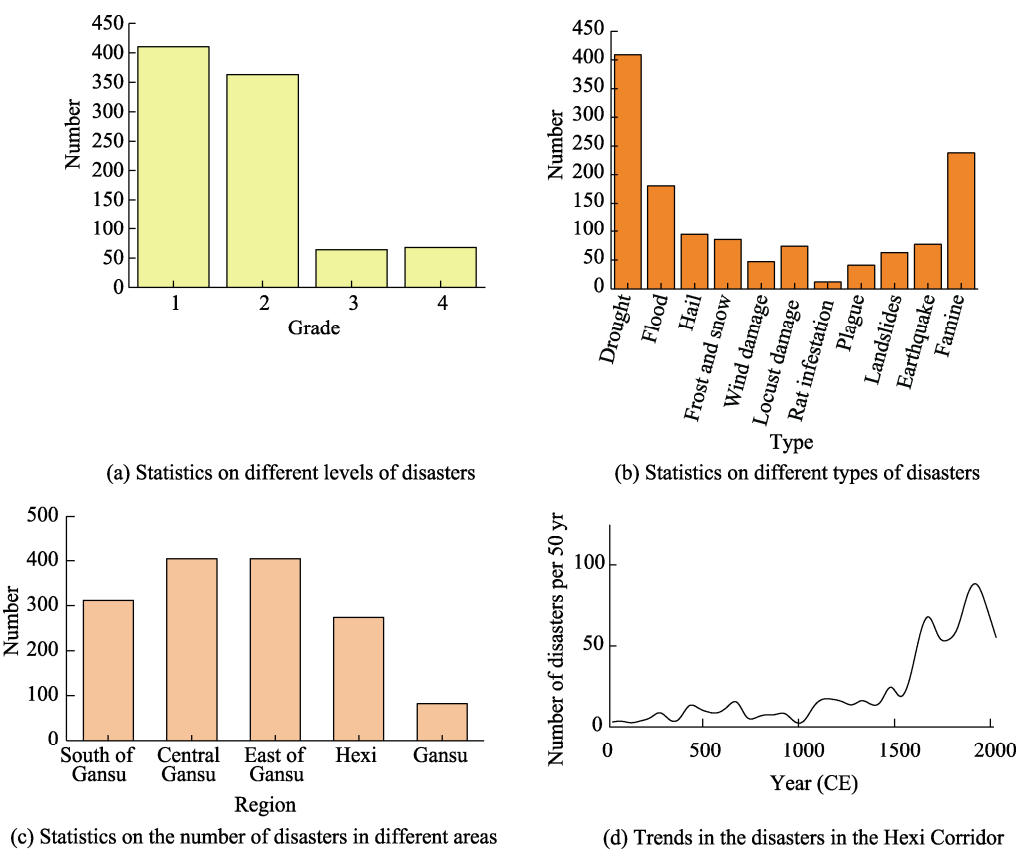


Figure 2 Statistics of disasters and famines in the Hexi Corridor.

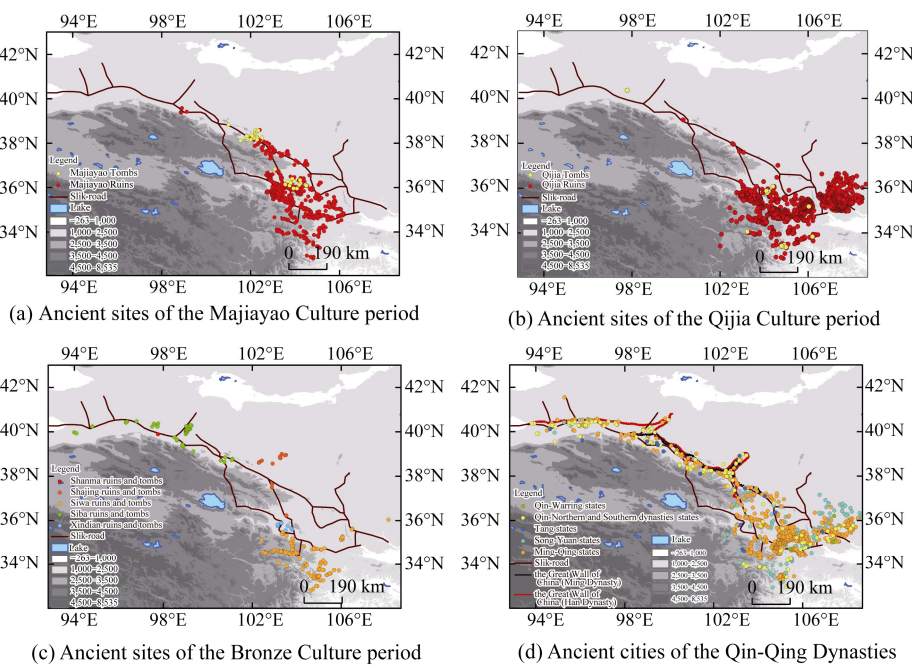


Figure 3 Maps of data on ancient sites and ancient cities in the Hexi Corridor

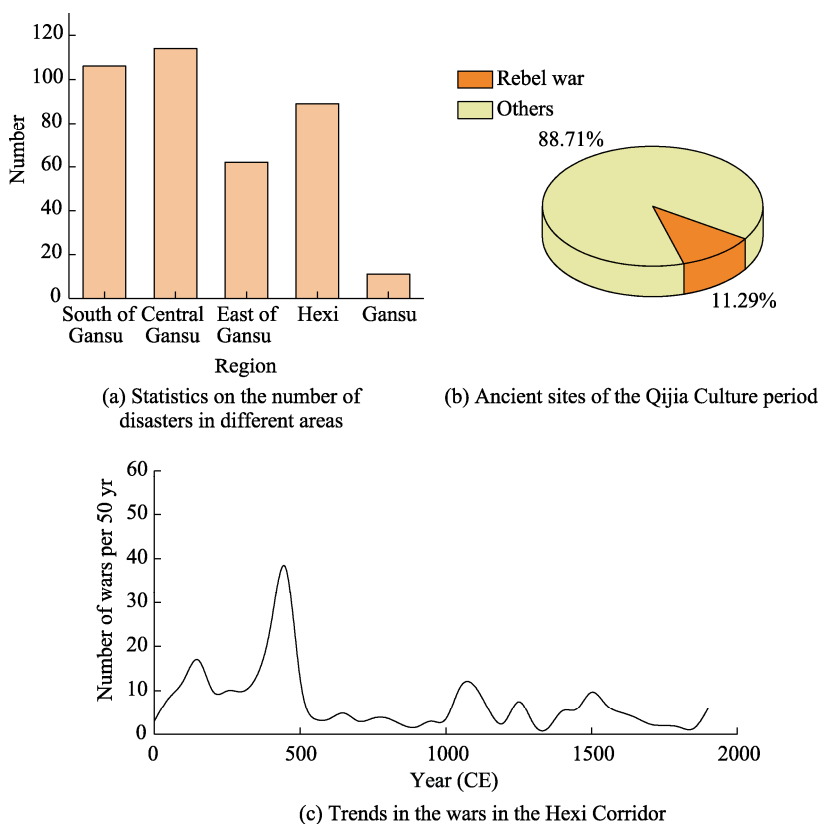


Figure 4 Maps of data on wars in the Hexi Corridor

Central Gansu and South of Gansu are hot areas of warfare, with few wars spreading throughout Gansu (Figure 4a). Rebel wars account for only about a tenth of the total number of wars (Figure 4b). The peak of warfare occurred before 500 CE, after which the population of the Hexi Corridor reaches its lowest value (Figure 4c, Figure 5). Many studies have analyzed the interaction between disaster, famine, war, and population. Although the curves show consistent or opposite trends, it seems that this alone is not entirely appropriate. By tracing a specific disaster event through time and space, we do not find social severe consequences, and the relationship between extreme events and social unrest remains uncertain.

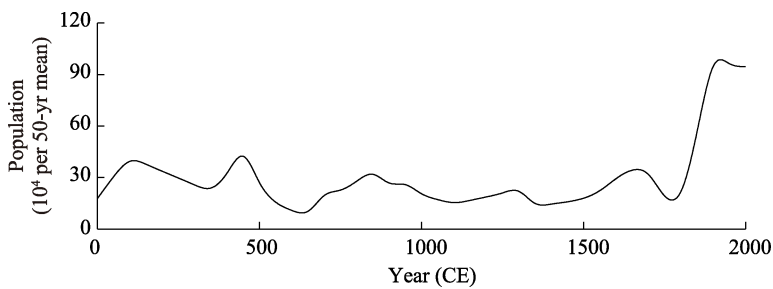


Figure 5 Trends in the population in the Hexi Corridor

5 Data Validation

5.1 Quality Control

The collection and extraction of a digital database of human activity is produced with strict quality control throughout the procedures. The location of ancient sites and cities is examined via professional GIS tools (ArcGIS) to ensure the accuracy of their geographic locations. For wars, disasters, and famines, it is necessary to match the time and place of occurrence, mainly due to differences in chronological methods and changes in administrative areas.

5.2 Uncertainties

This study aims to collect evidence of typical human activities in the Hexi Corridor region. Due to the complexity of the current sources of human activity data, the following spatiotemporal mismatches are common, i.e., the periods do not fully coincide, or the spatial extent does not fully overlap. This is inconvenient for correcting information from multiple sources and impacts the analysis of regional patterns. Although we have improved the accuracy of the data through integration and intercomparison, there is still uncertainty in the description of regional human activity patterns. For this reason, more efforts are needed to generate a more accurate database. On the one hand, deeper information mining on the Hexi Corridor is needed. In the future, we consider collecting human economic data, such as the extent of arable land and metal production, to analyze better the relationship between people and the environment in the region. On the other hand, machine learning will establish a standardized data extraction process to extract information on human activities in the data more accurately.

6 Conclusion

Through the collection and processing of research data related to the historical geography of the Hexi Corridor (e.g., research papers, books, scientific research reports, etc.), the database of human activities in the Hexi Corridor was obtained, which is a secondary development study based on the primary data. In producing the data, making human judgments on each is necessary, and the production process takes a long time. The human activity database of the Hexi Corridor obtained by this method has good accuracy in analyzing the spatial distribution, disaster evolution, and population change of the whole Hexi site in a long time range. However, it is less accurate for smaller fields such as counties and townships, which is mainly limited by the ambiguity of the data source records and the uncertainty of the administrative range in the historical period. Also, due to the diversity of data, there are cases of conflict with the original data, which also results in a decrease of the accuracy of the data.

As an important part of the Silk Road, the Hexi Corridor has been an essential passage for traders and the military for nearly a thousand years. Taking the Hexi Corridor as an example, this database completes a data architecture of human-land relations in a small region, which can be used to analyze the long-term evolution of human activities in the context of climate change in a targeted manner and can be used as a template for other regions seeking to understand their human-environmental history better.

Author contributions

Li, Y. designed the research; Gao, M.J implemented the research and analyzed the results.

Conflicts of Interest

The authors declare no conflicts of interest.

References

- [1] Burke, A., Peros, M. C., Wren, C. D., *et al.* The archaeology of climate change: the case for cultural diversity [J]. *Proceedings of the National Academy of Sciences*, 2021, 118(30): e2108537118.
- [2] Doblas-Reyes, F. J., Srensson, A. A., Almazroui, M., *et al.* IPCC AR6 WGI Chapter 10: Linking Global to Regional Climate Change [M]. Cambridge: Cambridge University Press, 2021.
- [3] Gornitz, V. Encyclopedia of Paleoclimatology and Ancient Environments: Encyclopedia of Earth Sciences Series [M], Dordrecht: Springer, 2009.
- [4] Lv, H. Y. Periodic climate change and human adaptation [J]. *Acta Anthropologica Sinica*, 2022(4): 41.
- [5] Valero-Garcés, B. L., Moreno, A. Iberian lacustrine sediment records: responses to past and recent global changes in the Mediterranean region [J]. *Journal of Paleolimnology*, 2011, 46: 319–325.
- [6] Chen, F. H., Chen, J. H., Huang, W., *et al.* Westerlies Asia and monsoonal Asia: Spatiotemporal differences in climate change and possible mechanisms on decadal to sub-orbital timescales [J]. *Earth-science Reviews*, 2019, 192: 337–354.
- [7] Weiss, H., Courty, M. A., Wetterstrom, W., *et al.* The genesis and collapse of third millennium north Mesopotamian civilization [J]. *Science*, 1993, 261(5124): 995–1004.
- [8] Sarkar, A., Mukherjee, A. D., Bera, M. K., *et al.* Oxygen isotope in archaeological bioapatites from India: Implications to climate change and decline of Bronze Age Harappan civilization [J]. *Scientific Reports*, 2016, 6(1): 26555.
- [9] Degroot, D., Anchukaitis, K., Bauch, M., *et al.* Towards a rigorous understanding of societal responses to climate change [J]. *Nature*, 2021, 591(7851): 539–550.
- [10] Berrang-Ford, L., Siders, A. R., Lesnikowski, A., *et al.* A systematic global stocktake of evidence on human adaptation to climate change [J]. *Nature Climate Change*, 2021, 11(11): 989–1000.
- [11] Shi, P., Wang, J., Yang, M., *et al.* Understanding of natural disaster database design and compilation of digital atlas of natural disasters in China [J]. *Geographic Information Sciences*, 2000, 6(2): 153–158.
- [12] Zheng, J. Y., Hao, Z. X., Di, X. C. A study on the establishment and application of environmental change database during historical times [J]. *Geographical Research*, 2002, 21(2): 146–154.
- [13] Li, Y., Wang, N. A., Li, Z. L., *et al.* Comprehensive analysis of lake sediments in Yanchi Lake of Hexi Corridor since the late glacial [J]. *Acta Geographica Sinica*, 2013, 68(7): 933–944.
- [14] Barisitz, S. Central Asia and the Silk Road: Economic Rise and Decline over Several Millennia [M]. Springer International Publishing, 2017.
- [15] Dong, G. H., Yang, Y. S., Liu, X. Y., *et al.* Prehistoric trans-continental cultural exchange in the Hexi Corridor, northwest China [J]. *The Holocene*, 2018, 28(4): 621–628.
- [16] Li, X., Gou, X. H., Wang N. L., *et al.* Tightening ecological management facilitates green development in the Qilian Mountains [J]. *Chinese Science Bulletin*, 2019, 64(27): 2928–2937.
- [17] Gao, M. J., Li, Y. Historical records dataset on human activity in the Hexi Corridor of China (from Neolithic to Qing dynasty) [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2023. <https://doi.org/10.3974/geodb.2023.07.09.V1>. <https://cstr.escience.org.cn/CSTR:20146.11.2023.07.09.V1>.
- [18] GCdataPR Editorial Office. GCdataPR data sharing policy [OL]. <https://doi.org/10.3974/dp.policy.2014.05> (Updated 2017).
- [19] Guo, R. H. Military history of China [M]. Beijing: PLA Publishing Press, 1986.
- [20] Tan, Q. X. The historical atlas of China [M]. Beijing: China Cartographic Publishing House, 1982.
- [21] Yuan, L. History of disaster and famine in Northwest China [M]. Lanzhou: Gansu People's Publishing House, 1994.
- [22] Feng, S. W. Compilation of historical and climate data on the Qilian Mountain and its surrounding areas [J]. *Northwest historical geography*, 1982(1): 1–18.
- [23] Li, B. C. Study on the changes of climate about aridity and humidity in history in Hexi Corridor [J]. *Journal of Northwest Normal University (Natural Science)*, 1996, 32(4): 56–61.
- [24] Yu, K. K., Zhao, J. B., Luo, D. C. Preliminary study on drought disasters and drought events in the Hexi Corridor in the Ming and Qing Dynasties [J]. *Arid Zone Research*, 2011, 28(2): 288–293.
- [25] Shun, J. L., He, Y. Q., He, Z., Pang, J. Study on the flood disasters and climate changes in the Hexi Corridor during Qing dynasty and the Republic of China [J]. *Journal of Arid Land Resources and Environment*, 2016, 30(1): 60–66.
- [26] Zhang, Y. P., Qi, C. J. Brief description of the population of Hexi past dynasties [J]. *Northwest Population Journal*, 1998(2): 6–12.
- [27] Cheng, H. Y. The desertification of the Hexi area in historical time [D]. Lanzhou: Lanzhou University, 2007.
- [28] Jiang, Q. J. A Study of the Population of Hexi through the Ages [M]. Hohhot: Inner Mongolia People's Publishing House, 2008.