Science Bulletin 63 (2018) 1023–1024

Contents lists available at ScienceDirect

Science Bulletin

journal homepage: www.elsevier.com/locate/scib

Science Bulletin
www.scibull.com

News & Views

Understanding past human-environment interaction from an interdisciplinary perspective

Guanghui Dong *

College of Earth and Environmental Sciences, Lanzhou University, Lanzhou 730000, China

Past human-environment interaction has become an increasingly important topic in the context of exploring the history of human and social evolution as well as their interaction with environmental change, a key scientific issue for multidisciplinary research across disciplines such as anthropology, archaeology, molecular biology and earth sciences. Such multidisciplinary research has made remarkable contributions to understanding the trajectory, patterns and mechanisms of human-land evolution from a long-term perspective, and also offers invaluable information on how best to respond to the challenges of rapid natural environmental change caused by global warming and extreme climate events now and in the future.

Three major issues concerning past human-environment interaction are highlighted: (1) how climate and environmental change have influenced the evolution of humans and human societies; (2) how ancient peoples adapted to different habitats and climate change; and (3) how human activities affected the surrounding environments during the prehistoric and historic periods. These issues represent different aspects of human-environment evolution and have been studied intensively over the past 20 years as indicated by a sharp rise in publications since ~2,000 CE (Common Era) in five comprehensive academic journals, that is, *Nature*, *Science*, *PNAS*, *Science Bulletin* and *Science China Earth Sciences* (Fig. 1a).

Major advances in our understanding of past human-environment interaction in the last two decades have been achieved mainly through the use of new research techniques and interdisciplinary cooperation among archaeologists, historians and natural scientists. The reconstruction of paleoclimate and paleoenvironmental change, and the chronologies of prehistoric cultures in different corners of the planet have facilitated comparative analysis of different sources of information and intensive dialogue on the relationships between human social evolution and past environmental variation under a changing climate.

According to the most up-to-date findings from these interdisciplinary studies, differences in the interactions between humans and their living environment occurred in different eras (Fig. 1b). Humans were engaged mainly in hunter-gatherer activities before 8000 BCE (Before the Common Era). These activities were intimately linked to variations in natural resources and regulated by climate change. For example, recent research suggests that orbital-scale global climate change may have caused four major waves of migration of *Homo sapiens* from Africa to Eurasia, and this influenced profoundly the distribution patterns of the global population during the Late Pleistocene [1]. Foragers could also adapt to climate fluctuations by selection of appropriate hunting and gathering tools, and improving these tools and hunting strategies. However, the influence of these Paleolithic groups on the natural environment may have been quite limited, expect for faunal evolution.

Around 8,000 BCE, the two early centers of plant and animal domestication emerged in the Fertile Crescent region of western Asia, and the valley regions of the Yangtze River and the Yellow River in China. The subsequent revolution in agriculture became one of the most important innovations in human history, which greatly improved the humans' capabilities to adapt to and alter the natural environment. A farming lifestyle spread widely throughout Eurasia between 8,000 and 2,000 BCE [2], roughly corresponding to the Neolithic era in China. Climate change was considered to be a key trigger for the cultural evolution on a regional scale during this period [3], and this might have contributed further to the emergence of early complex societies [4] and ancient civilization in northern China [5]. By comparison, the Neolithic cultural evolution in southern China has been suggested to have been affected by fluctuations in sea level [6]. Farmers, since the early Neolithic period, began to exploit the differing natural conditions by adoption of diverse subsistence strategies [7]. As a result, the impact by farmers on natural vegetation and landform appears to have been much more considerable than that in the Paleolithic era.

Trans-Eurasia culture exchange appeared between 3,000 and 2,000 BCE and intensified in the subsequent millennium [2]. This further altered the relationship between cultural evolution and climate change during the Bronze Age in China (~2,000–200 BCE). For instance, from about 1,600 BCE, humans began to inhabit land at higher altitudes, for instance, forming settlements in the high plains of the Tibetan Plateau (3,000 m above sea level) where the climate was cold and dry. This change was facilitated mainly by eastward diffusion of cold-tolerant barley across Eurasia in the mid-late Holocene, and by cultivation of this crop in high-altitude Tibet post 1,600 BCE [8]. Humans were able to adapt to climate change by adopting diversified livelihoods. Meanwhile, the

* Corresponding author.
E-mail address: ghdong@lzu.edu.cn

https://doi.org/10.1016/j.scib.2018.07.013

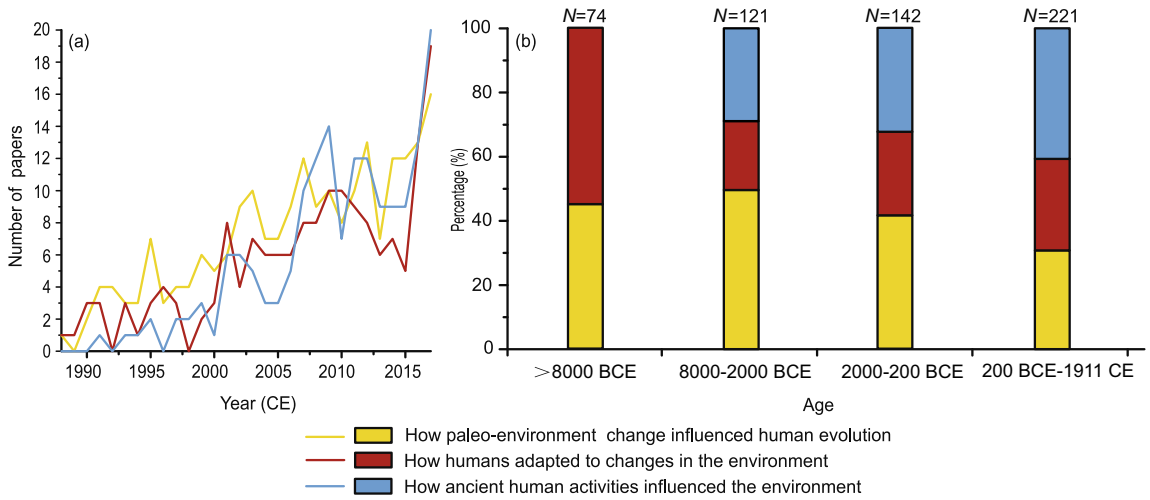

Fig. 1. Number of publications for past human-environment interaction (a) and proportion of themes in different eras for human evolution (b) for papers published in *Science*, *Nature*, *PNAS*, *Science Bulletin* and *Science China Earth Sciences* in the last 30 years.

technological innovation related to prehistoric globalization might have also increased human impact on the natural environment. This trend of diversified livelihoods can be further extended to the historical periods (Fig. 1b). A recent study has demonstrated that lead–silver mining and smelting activities in the Roman Republic and Imperial periods caused heavy metal pollution of the Arctic ice-sheet [9].

Such progress in research has increased our perception of how human-environment interaction has evolved from an interdisciplinary perspective. And prospects for further research remain promising, with deployment of new and effective methods, such as ancient DNA analysis and high-throughput sequencing, which are now being applied successfully in geoarchaeological studies [10]. Furthermore, the rapid accumulation of multi-disciplinary data for different continents, and the deepening collaboration of research groups from different countries, will advance past human-environment interaction research from a global perspective. In turn, this will promote further development of the above-mentioned disciplines.

Conflict of interest

The author declares that he has no conflict of interest.

Acknowledgments

This work was supported by the National Key R&D Program of China (2018YFA0606402).

References

[1] Timmermann A, Friedrich T. Late Pleistocene climate drivers of early human migration. Nature 2016;538:92–5.
[2] Dong GH, Yang YS, Han JY, et al. Exploring the history of cultural exchange in prehistoric Eurasia from the perspectives of crop diffusion and consumption. Sci China Earth Sci 2017;60:1110–23.
[3] Dong GH, Liu FW, Chen FH. Environmental and technological effects on ancient social evolution at different spatial scales. Sci China Earth Sci 2017;60:2067–77.
[4] Wu WX, Zheng HB, Hou M, et al. The 5.5 cal ka BP climate event, population growth, circumscription and the emergence of the earliest complex societies in China. Sci China Earth Sci 2018;61:134–48.
[5] Tan LC, Shen CC, Cai Y, et al. Great flood in the middle-lower Yellow River reaches at 4000 a BP inferred from accurately-dated stalagmite records. Sci Bull 2018;63:206–8.
[6] Zheng HB, Zhou YS, Yang Q, et al. Spatial and temporal distribution of Neolithic sites in coastal China: sea level changes, geomorphic evolution and human adaption. Sci China Earth Sci 2018;61:123–33.
[7] Wang C, Lü HY, Gu WF, et al. The spatial pattern of farming and factors influencing it during the Peiligang culture period in the middle Yellow River, valley, China. Sci Bull 2017;62:1565–8.
[8] Chen FH, Dong GH, Zhang DJ, et al. Agriculture facilitated permanent human occupation of the Tibetan Plateau after 3600 B.P. Science 2015;347:248250.
[9] McConnell JR, Wilson AI, Stohl A, et al. Lead pollution recorded in Greenland ice indicates European emissions tracked plagues, wars, and imperial expansion during antiquity. Proc Natl Acad Sci USA 2018;115:201721818.
[10] Feng Y, Dolfing J, Guo Z, et al. Chronosequencing methanogenic archaea in ancient Longji rice Terraces in China. Sci Bull 2017;62:879–87.

Guanghui Dong graduated from Peking University in 2005 with a Ph.D. degree in Physical Geography. He then began his research career in Lanzhou University and now holds the position of professor in College of Earth and Environmental Sciences, Lanzhou University. His current research interests include environmental archaeology and environmental change.