Ecological Environments of Tropical and Subtropical Regions in China

Jiasen Sun, Guo Li, Qunwei Wang, and Bin Zhang

Abstract
China's tropical and subtropical zones have high levels of economic development and are densely populated. However, the economic development and population growth have exacerbated ecological problems. This special issue provides a platform for sharing the latest studies on the ecological environments in the tropical and subtropical regions of China. The studies in this issue can be divided into three categories: (a) energy-saving and emission reduction, environmental efficiency, and carbon emissions; (b) relationship between economic development and the ecological environment; and (c) environmental protection services, public satisfaction, and corporate environmental obligations. In this special issue, some studies have adopted and expanded new methods in the field of ecological environment, and some studies have provided empirical evidence for meteorological disaster theory and household consumption behavior theory. In addition, the conclusions of some studies provide important recommendations to the government for policy formulation regarding the ecological environment, improvement of environmental protection services, and economic development.

Keywords
Tropical and subtropical regions, energy-saving, emission reduction, environment

The deterioration of the ecological environment has become one of the factors hindering the high-quality development of China's economy (Song et al., 2018). In recent decades, China's economy has grown rapidly as industrialization and urbanization have accelerated (Sun et al., 2019; Z. Wang et al., 2017). However, rapid development consumes a huge amount of resources and emits pollutants on a massive scale, which has severely affected the ecology and the environment (Liu et al., 2015; Sun, Li, et al., 2018) and human health and productivity (Williams, 2002).

Many studies have explored the relationships among China's ecology, environment, energy, and economic development but have not linked environmental and ecological issues to climatic factors (Ji et al., 2019; G. Li et al., 2019; Q. Wang et al., 2018; Zhang et al., 2018). In China, 15 provinces are located in tropical and subtropical regions. Compared with other regions in China, tropical and subtropical regions have higher levels of economic development and denser populations. Taking 2018 as an example, the gross domestic product of the tropical and subtropical regions accounted for 61.05% of the national gross domestic product and the population accounted for 58.06% of the country’s total population (Zhang, Ye, et al., 2019). With further urbanization, China will also have a large number of people moving from rural to urban areas, most of which are located in the tropical and subtropical regions. Such large migrations will exacerbate ecological and environmental degradation. Therefore, it is highly necessary and meaningful to study the ecological environment of China's tropical and subtropical regions to provide policy recommendations for China’s future development.
This special issue contains contributions from 44 authors who work in 27 organizations in the fields of economics, management, environmental science, and engineering. The papers can be divided into the following three categories.

1. Energy-saving and emission reduction (ESER), environmental efficiency, and carbon emissions

ESER has been one of the key measures of sustainable development (Du et al., 2012; S. Wang et al., 2014). L. Li (2019) improved the model of (Q. Wang et al., 2015) to evaluate the carbon emissions of 20 thermal power companies from 2010 to 2015 in the subtropical and temperate regions of China. The empirical results showed that, due to their use of advanced technology, the efficiency of power enterprises in subtropical regions was higher than that in temperate regions. This study provided important insight for the marketization of carbon trading and supported policy developments for power companies with lower marginal carbon emission reduction costs to become the mainstay of low carbonization in the Chinese power industry.

Zhang, Ye, et al. (2019) applied the model of Sun, Wang, et al. (2018) to study the environmental performances of China’s 29 provinces from 2006 to 2016. The empirical results showed that the environmental efficiency of mainland China was improved significantly during 2006 to 2016, but the environmental efficiency of the temperate zones was significantly lower than that of the other zones. The study verified the impact of climatic factors on regional environmental efficiency and also presented an important insight into the measurement of regional technology gaps. In addition, the study provided support for the formulation of environmental protection policies by the Chinese central government and local governments.

L. Li and Liu (2019) used a meta-frontier data envelopment analysis (DEA) to evaluate and analyze the ESER performances and technologies in each of China’s regions from 2014 to 2017. The empirical results showed that the overall ESER level in China is low. The authors also concluded that eastern China had the best ESER, whereas northeastern China had the worst. In terms of methodological innovation, this study provided an emission permits allocation model considering both efficiency and technology. In terms of policy recommendations, the study provided important insight for the government of China regarding policy formulation related to industrial structure, technology transfer, and emission targets to improve ESER performance.

To further limit carbon emissions, Hu et al. (2019) used a centralized DEA model to allocate carbon emission permits to 11 cities in China’s Zhejiang Province by using the data from 2011 to 2015. The results showed that the environmental efficiency was high in Zhejiang and a moderate reduction in carbon emissions would drive the economic growth of some cities. In terms of methodological innovation, this study provided the emission permits allocation model from the perspective of centralization. In terms of setting emission targets, this study provides a feasible reference for the year-by-year planning of emission reduction targets.

Zhou et al. (2019) proposed a nonradial DEA method to estimate the environmental efficiency of 30 China’s steel enterprises by using the data for the year 2010. The authors found that nearly half of China’s steel enterprises had low efficiency. In terms of methodological innovation, this study provided an improved directional distance function, which could provide guidance to managers of enterprises on how to reduce pollution while maintaining the current production levels. In terms of policy recommendations, this study provided support for the iron and steel industry in China to improve the environmental efficiency.

2. Relationship between economic development and the ecological environment

Luo et al. (2019) applied a gray relational analysis method to explore the relationship between energy consumption, environmental pollution, and economic growth by using the data of Guangxi from 2004 to 2017 and the data of Zhejiang from 2007 to 2017. The results showed that energy consumption drove economic development but caused environmental pollution. However, the environmental pollution would further hinder economic development. In terms of methodological innovation, this study provided an alternative method to deal with multiple variables and nonlinear variables in a multilevel and multifactor system of energy environment and economy. In terms of policy recommendations, this study urged China’s government...
to formulate policies related to subsidy, energy structure, energy efficiency, capital investment, laws, people’s awareness, education, and technology.

To promote the coordinated development of the economy and the ecological environment, Shi et al. (2019) applied the entropy and weighted regression methods to analyze the coordinated coupling relationship between economic development and ecological environment, using the data of 14 countries in Asia from 2003 to 2016. The empirical results showed that most of the countries in the sample were at the level of intermediate coordination coupling between economic development and ecological environment. The study provided an appropriate method to reflect the spatiotemporal heterogeneity of coordination in different regions and provided support for policy formulation regarding the coordinated development between the environment and economy.

3. Environmental protection services, public satisfaction, and corporate environmental obligations

The frequent occurrence of meteorological disasters has promoted the development of meteorological services in China. In addition to the efforts of government agencies, public support and participation in meteorological services are also crucial. To evaluate the satisfaction of meteorological services, Wu et al. (2019) first proposed the concept of public meteorological cognition and then applied a structural equation model to analyze the relationship between public meteorological cognition, perceived value, and meteorological service satisfaction based on the survey data of 3029 questionnaires from Shenzhen, China. The results showed that Shenzhen residents were generally satisfied with the meteorological services but dissatisfied with the availability of meteorological disaster warnings. In addition, the public cognition had a significant impact on satisfaction with meteorological services. This article provided empirical evidence for the theory of meteorological disasters and also provided policy rationale for the improvement of meteorological services in China.

Su et al. (2019) used the regression method to analyze factors that affect consumer satisfaction with air-source heat pump technology by the data from a survey of 256 residents in Beijing. The empirical results showed that convenience, design, reliability, and cost affected the consumer satisfaction, whereas product security had no significant effect. The study provided the empirical evidence for the theory of household consumption behavior. In addition, the study helped the manufacturing enterprises of a residential heating system to comprehensively understand the consumer’s preference for the product to improve the technical function of the product.

Ecological compensation could effectively protect the environment and maintain the livelihoods of farmers, but their expectations for such compensation are the key factors affecting the implementation of projects for compensation. Zhang, Li, et al. (2019) used regression models to analyze the main factors affecting farmers’ expectations about ecological compensation based on the survey data of 259 farmers in the area of returning farmland to forest in China. The empirical results showed that farmers were willing to participate in an ecological compensation project, but were not satisfied with the current compensation income. The study provided important insight for implementing the project of returning farmland to forest in China. In addition, the study provided support for the improvement of China’s ecological compensation policy.

Chen et al. (2019) first collected the land revenue data and environmental information disclosure (EID) data of 1,717 Chinese listed enterprises from 2012 to 2014 and then used a hierarchical linear model to analyze the impact of local governments’ financial competition on enterprises’ EID. The results showed that regional financial competition did not directly affect the quality of corporate EID but had a significant negative regulatory impact. The higher the degree of regional competition, the more significant were the negative regulatory effects. This study provided important insight for the government’s environmental protection department to monitor the environmental behavior of enterprises and also provided recommendations for the government to formulate laws and regulations to monitor the environmental emissions and information disclosure of enterprises.

Generally, most of the papers in this special issue cover the coordinated development of the ecological environment and economy. China’s rapid development in recent decades has also experienced other problems, which include the effective management of rural ecological environments, improvement of the public’s ecological awareness and enthusiasm for participation, construction of ecological urban agglomerations, and improvement of technology for environmental protection. All these problems worth further discussion and future research.

Acknowledgments

The authors would like to express our sincere thanks to Prof. Darren Norris (Editor-in-Chief of Tropical Conservation Science), Dr. Sarah Bologna (Managing Editor), and Bree Sundling (Associate Editor, SAGE Publishing). The authors would also like to express our gratitude to the authors for their contributions, the reviewers for ensuring the quality of the accepted papers, and the staff of the Editorial Office and Production Department for their help in finalizing this special issue.
Declaration of Conflicting Interests
The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding
The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research is funded by the National Social Science Foundation of China (Project no. 19BGL188).

ORCID iD
Bin Zhang https://orcid.org/0000-0002-1048-9271

References
Chen, H. T., Han, W., & An, M. L. (2019). Regional fiscal competition and corporate environmental information disclosure: Provincial-level evidence from China. Tropical Conservation Science, 12.
Du, L., Wei, C., & Cai, S. (2012). Economic development and carbon dioxide emissions in China: Provincial panel data analysis. China Economic Review, 23(2), 371–384.
Hu, D., Fang, Y., Feng, C., & Cheng, J. (2019). City-level carbon emission abatement in the subtropics of China: Evaluation and reallocation for Zhejiang. Tropical Conservation Science, 12.
Ji, X., Sun, J., Wang, Q., & Yuan, Q. (2019). Revealing energy over-consumption and pollutant over-emission behind GDP: A new multi-criteria sustainable measure. Computational Economics, 54(4), 1391–1421.
Li, G., Sun, J., & Wang, Z. (2019). Exploring the energy consumption rebound effect of industrial enterprises in the Beijing–Tianjin–Hebei region. Energy Efficiency, 12(4), 1007–1026.
Li, L. (2019). Carbon emission reduction of power enterprises in subtropical and temperate regions of China. Tropical Conservation Science, 12(6).
Li, L., & Liu, X. (2019). Allocation of regional emission permits in China: Based on the technology of energy conservation and emission reduction. Tropical Conservation Science, 12(2).
Li, Y., Chiu, Y. H., Wang, L., Liu, Y. C., & Chiu, C. R. (2019). A comparative study of different energy efficiency of OECD and non-OECD countries. Tropical Conservation Science, 12(9).
Liu, Y., Zhou, Y., & Wu, W. (2015). Assessing the impact of population, income and technology on energy consumption and industrial pollutant emissions in China. Applied Energy, 155, 904–917.
Luo, X., Lu, L., Wang, Z., & Yang, L. (2019). Gray correlation analysis of energy consumption, environmental pollution, and economic growth in subtropical regions of China: Guangxi and Zhejiang as examples. Tropical Conservation Science, 12.
Shi, T., Weiteng, T., Zhang, W., & Zhou, Q. (2019). Spatiotemporal relationship between ecological environment and economic development in tropical and subtropical regions of Asia. Tropical Conservation Science, 12(8).
Song, M., Peng, J., Wang, J., & Dong, L. (2018). Better resource management: An improved resource and environmental efficiency evaluation approach that considers undesirable outputs. Resources, Conservation and Recycling, 128, 197–205.
Su, D., Zhou, W., Du, Q., & Huang, Y. (2019). Technical characteristics in the diffusion of cleaner residential heating system in China: The case of air-source heat pump technology. Tropical Conservation Science, 12(2).
Sun, J., Li, G., & Wang, Z. (2018). Optimizing China’s energy consumption structure under energy and carbon constraints. Structural Change and Economic Dynamics, 47, 57–72.
Sun, J., Li, G., & Wang, Z. (2019). Technology heterogeneity and efficiency of China’s circular economic systems: A game meta-frontier DEA approach. Resources, Conservation and Recycling, 146, 337–347.
Sun, J., Wang, Z., & Li, G. (2018). Measuring emission-reduction and energy-conservation efficiency of Chinese cities considering management and technology heterogeneity. Journal of Cleaner Production, 175, 561–571.
Wang, Q., Hang, Y., Su, B., & Zhou, P. (2018). Contributions to sector-level carbon intensity change: An integrated decomposition analysis. Energy Economics, 70, 12–25.
Wang, Q., Su, B., Sun, J., Zhou, P., & Zhou, D. (2015). Measurement and decomposition of energy-saving and emissions reduction performance in Chinese cities. Applied Energy, 151, 85–92.
Wang, S., Fang, C., Guan, X., Pang, B., & Ma, H. (2014). Urbanisation, energy consumption, and carbon dioxide emissions in China: A panel data analysis of China’s provinces. Applied Energy, 136, 738–749.
Wang, Z., Deng, X., Wang, P., & Chen, J. (2017). Ecological intercorrelation in urban–rural development: An eco-city of China. Journal of Cleaner Production, 163, S28–S41.
Williams, R. C. (2002). Environmental tax interactions when pollution affects health or productivity. Journal of Environmental Economics and Management, 44(2), 261–270.
Wu, X., Cao, Y., Gao, G., Zou, Y., & Guo, J. (2019). Relationship among public cognition, perceived value, and meteorological service satisfaction. Tropical Conservation Science, 12(5).
Zhang, B., Li, P., Xu, Y., & Yue, X. (2019). What affects farmers’ ecocompensation Expectations? An empirical study of returning farmland to forest in China. Tropical Conservation Science, 12(05).
Zhang, B., Lu, D., He, Y., & Chiu, Y. H. (2018). The efficiencies of resource-saving and environment: A case study based on Chinese cities. Energy, 150, 493–507.
Zhang, B., Ye, S., Wang, W., Huang, F., & He, Y. (2019). Climate drives environmental efficiency across Chinese provinces. Tropical Conservation Science, 12(1).
Zhou, Z., Wu, H., Ding, T., & Xia, Q. (2019). Nonradial directional distance function for measuring the environmental efficiency of the Chinese iron and steel industry. Tropical Conservation Science, 12(2).