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Research progress and prospect on development geography

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Abstract: In this paper, we review the research progress in development geography since the 20th century, focusing on its connotation and theory, fields, methods, and development trends. Specifically, we systematically review the research and applications of development geography, comprising fields such as the convergence of underdeveloped countries and regions, and the convergence of the process of improving the quality of life in developed countries and regions. Then, based on an analysis of research progress in development geography in foreign countries, we examine the development conditions and disciplinary advantages of development geography in China. Further, we highlight that future development geography research in China should focus on the latest international academic research and China's national macro-strategic needs. Future research in development geography should be guided by the theory of sustainable development, the core of which is to improve sustainable livelihood capacity and regional green development levels in underdeveloped regions. This core includes the construction of industrial policy and development geography theory, as well as an interdisciplinary integrated research system. The focus must be placed on researching the spatial patterns, diffusion characteristics, and the convergence mechanism of regional development. Such a focus will facilitate exploration of the regulatory policies and scientific paths that serve regional economic construction and industrial development.

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1 Introduction

Development geography involves the level of human development and the quality of life, and it primarily focuses on the convergence of development in underdeveloped and developed areas under environmental constraints, as well as the convergence of the improvement in human well-being. As one of the new branches of geography, development geography boasts typical interdisciplinary characteristics. At its core, it explores the mechanism of global inequality and large-scale poverty (Dong *et al*., 2021), as well as the relationship among development, economic, political, and social factors that play an important role in social practice. Development geography originated from colonial studies in the 1930s, and mainly concentrated on wartime intelligence services and post-war social reconstruction in the late 1940s (Power *et al*., 2004a). The research in this period is closely related to the term "underdeveloped areas". In the 1960s, Marxism facilitated change in development thought and practice, and development geography moved its focus from emphasizing economic growth to investigating social welfare and freedom (Lawson, 2007). The first undergraduate course in development geography was in the University of East Anglia in the 1970s (Potter *et al*., 2012), which accelerated the subject's development and the cultivation of its associated expertise. With globalization in the 1980s, the research topics of development geography gradually focused on the balanced development of underdeveloped and developed areas, and the improvement of the quality of life in developed areas (Haan *et al*., 2003). Research results centered on the sustainable development of underdeveloped areas. The development mechanism and strategy of the company have been analyzed in depth, and modernization theory, dependency theory, post-modernization theory, neoclassical theory, neo-Marxism, and neo-liberalism have been formed successively (Hodder, 2005). In recent years, development geography has comprehensively applied new information technology, spatial economics, and other research methods to measure the spatial pattern, heterogeneous characteristics, diffusion state, and convergence mode of national and regional development. Such a comprehensive application provides technical support for regional sustainable development and facilitates the rapid evolution of development geography related research.

Accompanied with rapid social and economic development under the background of economic globalization, contradiction of China's uneven and inadequate regional development among regions is sharpening. China faces serious challenges, such as poverty, transformation of development methods, international trade competition, climate change, and environmental degradation. Because of the challenges inherent to regional sustainable development in China, geographical knowledge is urgently needed to guide industrial transformation and development, to alleviate pressure on resources and environment and to optimize the sustainable territorial development. Domestic geographers have conducted much research on the development of underdeveloped areas. Foreign related research theories and methods act as a guide in development geography research. This paper reviews the recent research progress of development geography globally, and discusses such future research with respect to China. This work builds a strong theoretical foundation for China to formulate regional development policies and realize regional coordinated development, thereby

enhancing development geography in China and enriching the disciplines of domestic geography.

2 Connotation and theoretical research of development geography

2.1 Connotation of development geography

Development geography incorporates disciplines such as management, economics, and ecology, and is comprehensive, interdisciplinary, and regional. In view of the connotation of modern development geography, foreign scholars have defined the concept of development geography. Development geography is a discipline that studies the development theory and strategy of social economies under specific environmental conditions, with underdeveloped countries as the research object (Chant *et al*., 2009). Escobar (2011) reviewed development processes of the third world, and believed that development geography mainly studies the mode and state of human well-being in developing society, focusing on the comprehensive spatiotemporal analysis of the causes and consequences of inequality. In other words, development geography studies the level of human development and quality of life (Potter *et al*., 2017). In general, development geography has always been centered on "geographical research closely combined with the relationship between human beings and geographical environment" (Bauer, 1996). Focus has been on the study of the spatiotemporal patterns of development, from the perspective of geography, analyzing the relationship among developmental, social, economic, and political structures, and other key elements (Jin *et al*., 2020). The discipline has also focused on the developmental differences between developed countries and regions and underdeveloped countries and regions, to aid sustainable development.

"Development" is the core element of development geography, whose main aim is to explore the connotation of "development" in combination with different research backgrounds and perspectives. Development itself is a complex and dynamic concept, which has a specific significance in cultural and political contexts. As an economic concept, "development" was first formed in the 1850s, and concerned material products and economic growth in the early stages. After the 1870s, the concept began to shift its focus from the growth of material quality to other aspects of economic and social changes. From a broad perspective, development refers to the intention of development, focusing on the global and national levels of governmental and non-governmental organizations to promote the economic growth and social progress of underdeveloped countries and regions and their major impact analysis (Bebbington, 2003). From a narrow perspective, development involves economic, social, and political processes that affect people's lives—such processes include urban and population development, technological change and industrial development, regional coordination and social equity, poverty eradication, and improvement of life quality (Potter *et al*., 2017) (Figure 1). Todaro (1982) believed that the concept of development must include the developmental processes inherent to social and economic structure, public concept, and policies and systems. Dickenson *et al*. (1996) proposed that development should include freedom of action and speech, so that people can have a wider choice; Hodder (2005) held that development can be defined as the continuous improvement of human development levels, quality of life, and political participation. Kothari *et al*. (2016) pointed out that the goal of development is to reduce poverty and inequality in order to improve human well-being and qual-

ity of life. Different definitions of "development" established different key development goals, including economic growth, technological change, equality and equity promotion, and improvement of social structure. In essence, development should comprise the multidimensional interests of human social development, incorporating different subjects, different levels, and different social and economic backgrounds. How to define the key objectives and standards within development is an important challenge in the study of development geography.

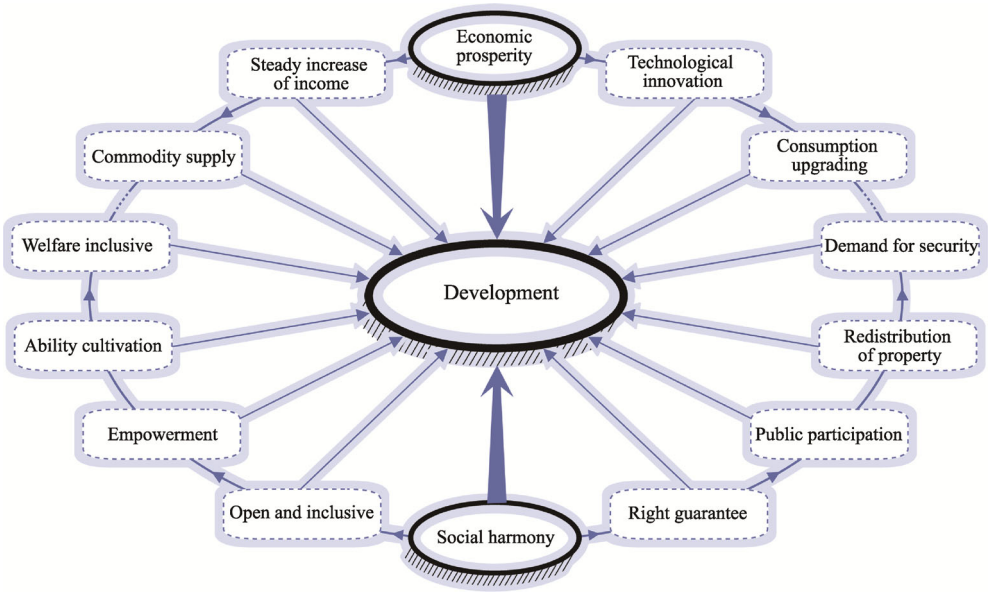

Figure 1 Aspects of the "development" concept

The discipline of development geography is based on geography and integrates management, economics, ecology, and other disciplines. The discipline continues to become an important analytical tool to solve problems in regional development, such as non-convergence and imbalance. Practical research on development originated in the 1940s from development practice and a concept based on practice. Development geography is interdisciplinary in nature and utilizes different aspects of social science. Governments, international agencies, non-governmental organizations, and community-based organizations are involved in policy construction to promote development in the field (Willis, 2011). Mainstream social sciences, such as political science and sociology, demography, international relations, anthropology and history, and urban and regional planning, have also contributed to development research (Potter *et al*., 2012) (Figure 2). At present, geographers with regional research knowledge, actively participate in development practice by using the economic methods for reference, and by facilitating the evolution of development geography (Potter *et al*., 2017). In contrast with other branches of geography, development geography aims to address two main challenges, one is whether the development of underdeveloped countries or regions is convergent; the other is whether the process of improving quality of life and human well-being in developed countries or regions is convergent. With global environmental change, global economic integration, and global geopolitical structure change, different regions are faced with different problems affecting human social welfare, such as poverty, regional develop-

ment imbalance, and ecological degradation. Using development geography to promote transformational development, alleviate the pressure on resources and environment, and to achieve the Sustainable Development Goals (SDGs) has become a hot topic.

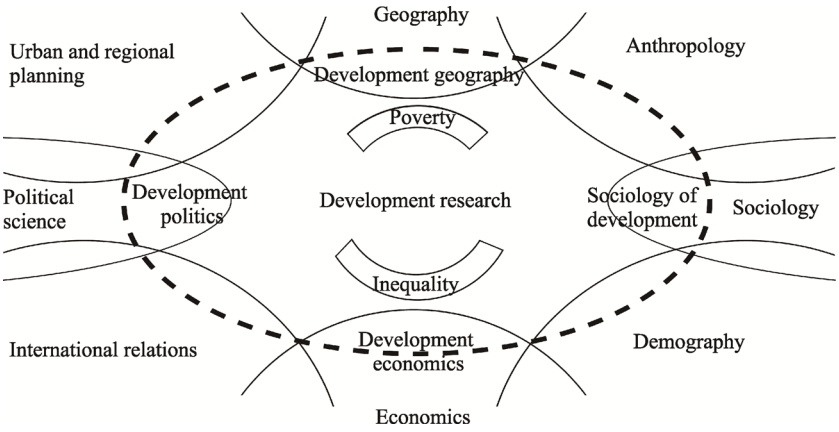

Figure 2 Links among development geography and related disciplines

2.2 Theoretical discussion on development geography

Since the 20th century, development geography has mainly focused on theoretical research, including the differentiation of development concepts, the analysis of key elements, and the comparison of underdeveloped countries or regional development models. This research mainly comprises the following four stages:

(1) The early stage of modernization theory research. From the 1940s to the end of the 1950s, scholars in the fields of development geography successively proposed the concept of promoting national economic development and social transformation. Modernization theory has a multi-disciplinary nature in terms of construction and ideology, but its powerful influence has promoted the spread of Western capitalist economic models, and modern innovation and technology, in less developed countries. The theory was shaken in the late 1950s, Myrdal (1957) believed that the circular causality of poverty could be broken through industrialization, and emphasized the importance of the welfare and freedom of human society.

(2) The dependency theory research stage. In the 1960s, radical political views emerged across society and mainstream social sciences, which promoted the emergence of dependency theory. The theory, derived from the development of Latin America and the Caribbean, posited that the Western-led global development model only plays a role in maintaining the status quo of poor countries and regions, rather than helping their societies accelerate development and eliminate poverty (Gunder, 1978). During this period, humanistic concepts, such as postmodernism and post-structuralism emerged, which are widely used in interdisciplinary development research. Harvey (1975) developed Marx's thoughts into a set of doctrines that fully explained the geographical mechanism of capital accumulation. Its core concept is the "spatial outlet" of capital, which made people gradually accept the political economy and structuralism in anthropogeography in the mid-1970s. At the same time, it proposes a bottom-up model to meet the basic development needs of less developed countries and regions.

(3) The neoclassical theory research stage. After the 1980s, western countries represented

by the Reagan and Thatcher governments abandoned Keynesian policies, implemented Hayek's neoliberalism, drastically reduced government intervention, privatized state-owned enterprises, and took measures to promote investment and trade liberalization (Hudson, 2016). At the same time, under the influence of early structuralist development economics theory, most countries that relied on planning, nationalization, and industrialization to accelerate capital accumulation encountered various contradictions and problems in the course of economic operation. In sharp contrast, those less developed countries or regions that were more open focused on the role of the market and implemented export-oriented strategies, making a major breakthrough in the economy. Economic reforms in Latin American countries have further consolidated the mainstream status of neoliberal economic thought in economic theory (Edwards, 1995). The main feature of this stage is the rise of "neo-rightism" in Europe and "neo-conservatism" in the United States.

(4) The stage of pluralistic theoretical research. Since the beginning of the 21st century, the number of theoretical works in development geography has gradually increased, and development geographers have gradually shifted their research focus from large- to small-scale development process research. This research includes basic movements, justice and democracy, citizen sovereignty, global conflict, environmental change, and other salient issues related to development convergence. Postmodernism became another paradigm of social science at the beginning of this century. The new growth theory emphasizes the important role of government policies in promoting long-term social and economic growth and development (Gibson, 2002). Power *et al*. (2004a) rethought the discourse power and geopolitics of development geography quality, exploring the spatiality of developing thought and practice. Lawson (2007) believes that future development geography must be based on the relationship between people's global and regional material life and discourse power to study discourse power and policy development in neo-liberalism economies. By summarizing the evolution, theory, and practical application of research thinking related to development geography, Potter *et al*. (2017) opened a new perspective on the relationship between employment, population, culture, and other factors in development.

2.3 Sustainable development goals in development geography

Sustainable development is an important part of development geography. Development geography is of great significance in solving multi-dimensional development problems, such as those in society, the economy, politics, and the environment faced by the region from the perspective of comprehensive development geography and the multi-disciplinary advantage, so as to promote the realization of SDGs. Against the background of global change, human social development is facing many challenges, especially in areas with a fragile environment, relative lack of resources, and frequent poverty, where the sustainable livelihood of humans needs to be improved. Since the 1990s, to address the challenges of sustainable development, the United Nations has held many summits with a view to achieving sustainable development at the global level. The summits have included the goal system of Agenda 21, Millennium Development Goals (MDGs), The Future We Want, and SDGs (Le *et al*., 2015). Among them, MDGs combine the concepts involved in development with those involved in measuring poverty and development level, providing a great impetus for global development (Table 1). However, there are still huge gaps in the implementation of MDGs around the

world, and new challenges are emerging. In order to encourage the international community to continue to substantially cooperate in major issues of human development, the United Nations adopted the resolution of sustainable development goals in the Agenda 2030 for Sustainable Development in 2016 to replace MDGs. The main aim of the Agenda 2030 for Sustainable Development is to set global sustainable development goals to be achieved by 2030, with a series of systems and mechanisms to promote international development financing and technology transfer that are formulated around the global sustainable development goals; and the global sustainable development governance system is reconstructed, which will have an important impact on the development space of countries and even the domestic development policies, and has been widely concerned by the international community (Reid *et al*., 2017). With an in-depth understanding of global sustainable development issues, the SDGs present succession and upgrading, which is consistent with the core areas of development geography, not only focusing on the improvement of material life but also on the comprehensive development of human society and ecosystem health. Therefore, promoting the theoretical discussion and practical application of development geography will provide an important tool for promoting sustainable development research.

Table 1 Major progress towards the MDGs in the core area of development geography (United Nations, 2015)

Goal	Major progress
Goal 1: eradicate extreme poverty and hunger	The number of people living in extreme poverty has declined from 1.9 billion in 1990 to 836 million in 2015; the rate of extreme poverty in developing countries has dropped from 47% in 1990 to 14%.
Goal 2: achieve universal primary education	From 2000 to 2015, the net primary school enrollment rate in developing regions increased from 83% to 91%; from 1990 to 2015, the global literacy rate of 15–24-year-olds increased from 83% to 91%.
Goal 3: promote gender equality and empower women	By 2015, developing regions as a whole have achieved the specific goal of eliminating gender disparities in primary, secondary and higher education.
Goal 4: reduce child mortality	From 1990 to 2015, the mortality rate of children under 5 years of age decreased by more than half, from 90 deaths per 1000 live births to 43 deaths.
Goal 5: improve maternal health	From 1900 to 2013, the number of maternal deaths per 100000 live births dropped from 380 to 210, and the maternal mortality rate decreased by 45%.
Goal 6: combat HIV/AIDS, malaria and other diseases	From 2000 to 2013, the number of new HIV infections decreased by about 40%, from 3.5 million to 2.1 million.
Goal 7: ensure environmental sustainability	From 1990 to 2015, the proportion of people with access to improved drinking water increased from 76% to 91%; from 2000 to 2014, the proportion of people living in slums in developing countries decreased from 39.4% to 29.7%.
Goal 8: develop a global partnership for development	From 2000 to 2014, the real value of official assistance from developed countries rose from 81 billion US dollars to 135.2 billion US dollars, an increase of 66%.

Note: According to the relevant contents of the United Nations Millennium Development Goals Report 2015.

3 Directions and issues of interest for development geography

Development geography is mainly reflected in the pluralism of theories and applied practices in related fields. Related theories cover concepts such as modernity, post-modernity and post-structuralism, radical development theory, neoliberalism, and the spatial nature of development issues. These theories argue for the need for global institutions and sustainable development, for the balanced development of underdeveloped regions, and for the convergence of developed regions in the process of improving quality of life in both the research

topics provide a theoretical basis. These two areas of research are mainly concerned with the retrospective causes of underdevelopment, the characterization of development convergence, and the process of development convergence (Henderson *et al*., 2001). By studying the spatial patterns of development in different countries and regions, and by comparing the internal and external differences between underdeveloped and developed countries, development geographers analyze the economic, political, and social factors that influence development characteristics, as well as the mechanisms of spatial differentiation, diffusion, and convergence. The research topics of development geography and development convergence include the following aspects.

3.1 Traceability and development convergence of underdeveloped countries or regions

3.1.1 Population imbalance and regional division of labor

From a development perspective, population is regarded as a geographical resource factor, and is often measured by indicators such as population scale density, distribution, growth rate, age structure, migration, and population quality. When comparing levels of development among countries, population quality is more important than other indicators, especially health, education, and human rights. Major advances in this area, which focus on marginalized groups, include child labor; diverse pathways of transition from childhood to adulthood (Arora *et al*., 2004); constraints on adolescents' rights, health, well-being, and indicators affecting their education (Ansell, 2016); links between the status of women, gender inequality, and development, and shifts in gender thinking in development policies (Jayachandran, 2015); rights and the voice of the disabled (Oliver *et al*., 2012); the current situation and challenges of population ageing in developing countries (Shrestha, 2000); social reproduction, gender division of labor, and inter-household relations (Jarrett, 2014); and studies on the forms and factors of migration, and the impact of population migration on the potential for social development at source and destination (Choudhury *et al*., 2020).

3.1.2 Cultural diversity and regional differences

Since the mid-1990s, cultural factors have become increasingly important in development geography. The changing relationship between culture and development has led to the emergence of a "cultural turn" in development policy and practice (Barnes, 2001). Development policy formulation needs to be integrated with the living practices, social relations, and cultural values of a given area in order to realize people's basic economic, social, and cultural rights. The more systematic research achievements in this area include a better understanding of the concept of culture under different theories and ideologies, and the development of basic theoretical perspectives, such as ethnocentric culture and values, cultural relativism, and cultural determinism (Power, 2004b); analyzing the influence of specific cultural elements, such as race, class, religion, gender, and vulnerable groups on different economic levels, and exploring the stages of their changes and dynamics (Pittaway *et al*., 2010); constructing a rights-based approach to development, pointing to the relationship between human rights and potential social challenges and development (Wise *et al*., 2013); and proposing a new model for integrating culture and economic development in light of cultural and ethnic differences in less developed countries or regions (Bandelj, 2015). Related studies have also explored the development of feminism, analyzed the changes in women's lives, and discussed the links between the expansion of women's economic and

political rights and economic development (Fernández, 2014; Razavi, 2016).

3.1.3 Regional poverty and reduction

Global inequality and large-scale poverty headcount ratios are key in development geography, and are one of the most significant topics researched by development geographers. Latest data in the United Nations Human Settlements Programme indicates that, although the global population is becoming increasingly urbanized, the rural poverty population rate is increasing, and rural poverty and agriculture are still the core issues in global development. Scholars have discussed and analyzed social poverty issues from different perspectives. Potter *et al*. (2012) and Desai *et al*. (2013) deemed that the important factors in causing poverty are health, education, social life, environmental quality, political liberal, spiritual freedom, and income and consumption. The related results are as follows. First, identified the reasons for poverty in underdeveloped areas, dynamic mechanism, and spatial geographic poverty (Li *et al*., 2019). Second, identified the spatial distribution pattern and space-time evolution characteristics in poverty-stricken areas (Jin *et al*., 2018), and came up with a way of escaping poverty–a poverty-alleviating strategy choice and a regional anti-poverty policy (Wang *et al*., 2018). Third, analyzed the relationship between poverty-stricken areas and economic development in different regions, explored and formulated an efficient income distribution policy in order to realize development convergence and social equity (Mark *et al*., 2008). Furthermore, the method of measuring regional, multi-dimensional poverty was explored, providing a research platform to study regional poverty and poverty reduction.

3.2 Convergence in the process of improving the quality of life in developed countries and regions

3.2.1 Research in environmental sustainability

As input factors of human survival and activity, resources and environment are significantly impacted by human activity (Li *et al*., 2017). Neoliberalism is a core concept that has dominated the global economy for a considerable time. Neoliberalism's mode of resource development, as well as its related market-driven objectives, has led to a broken ecosystem and a cycle of human poverty, which are the main obstacles for the development of environmental sustainability. Research in environmental sustainability, originating from global environmental-change research, is a "future-earth" research plan combined with social science research. Environmental sustainability research provides essential theoretical knowledge and research methods for countries, regions, and societies that seek developmental methods. The field attaches importance to ecosystem service function and the relationship between its changes and human well-being; the field also studies the impact of its changes on human material needs, security, health, social relations, freedom, and options (Leemans *et al*., 2003). There are more systematic achievements in it. Based on changing concepts and practices in environmentalism and development thought, people explore the competitiveness of sustainable development (Martin, 2014). The factors that restrict the sustainable development of the environment are highlighted and the mode of realizing such sustainable development is put forward (Nissing *et al*., 2010). People optimized land-use management to improve ecosystem service, as well as ascertaining the Environmental Sustainability Index (ESI) and estimating future national environmental protection capability (Babcicky, 2013). Furthermore, in the study of the influence of national land-space management on global environmental

change, development geographers have proposed a sustainable development path that uses the perspective of land use (Riebsame *et al*., 1994; Guo *et al*., 2020).

3.2.2 Change in regional development method

In recent years, with the improvement in research methods and technologies, as well as the interest in whether or not undeveloped countries and regions are converged, research that links regional agriculture, rural development, balanced industry, and urban development has come to the fore in development geography (Dong *et al*., 2020). Significant progress has been made in the study of regional development patterns and policies. The trade reform of neoliberalism is closely related to the agriculture, industry, and service industry of undeveloped countries (Bryceson, 2002). This reform affects livelihoods and production modes in undeveloped countries. Related research topics of trade reform mainly involve two aspects, the first aspect is about interregional rural, agriculture and development convergence, as well as city, industry, and development convergence (Moseley *et al*., 2010), including the influence of neoliberal economic reform on rural areas and agriculture; on non-agriculture in rural areas and diversification of livelihood systems; on land reform and rural economic revival (Lahiff *et al*., 2010; Sallu *et al*., 2010; Kušková, 2013); on the influence of innovative agricultural production modes on rural development and farmers' welfare (Dawson *et al.*, 2016); and on sustainable livelihood framework, a new paradigm of rural development and rural coordinated development (Nesar *et al*., 2010). The second aspect is about convergence of city, industry and development, including a renovation model and comprehensive improvement in poverty-stricken, urban, residential areas (Kelly, 2010); the interaction between urban and rural areas in undeveloped countries, expanding metropolitan and suburban development, the promotion of the reform of urban management mode on sustainable urbanization (Xi *et al*., 2015); sustainable development and the improvement in urban living quality (Khalil, 2012; Turkoglu, 2015).

3.3 Realization of the objective function of development geography

3.3.1 Multilateral trade and global governance program

The world today is undergoing complex and profound changes. The profound impact of the global financial crisis continues to emerge, and investment and trade patterns and multilateral investment and trade rules are constantly being adjusted, making the development problems faced by less developed countries or regions especially serious. The geopolitical driving factors of development cooperation and exchange among "South-South" countries and the aid donation plans of "economically underdeveloped countries" are analyzed (Leite *et al.*, 2015). The development cooperation between North and South and within is re-expounded, the necessity of South-South cooperation is emphasized (Mawdsley, 2012), and the cooperation between regional groups is highlighted as an important way for less developed countries and regions to eliminate trade barriers. The main research areas concern about the international financial center around regional trade and development, world free-trade zones, trade protectionism, and the World Trade Organization. Relevant studies also discuss various forms of aid, such as government aid, aid from international organizations, and humanitarian aid (Essex, 2013), complexity in aid patterns, emerging countries, and global development aid patterns and challenges (Kanbur *et al.*, 2012). The Belt and

Road Initiative in recent years has become a new mode for further promoting the economic globalization and regional economic cooperation and a new platform for exploring global economic governance. The scholars put forward the scientific connotation of the Belt and Road Initiative and scientific problems (Cheng, 2016), and pointed out the possible influence of the Belt and Road trade development on global trade pattern and global economic pattern (Ran, 2017), explored the recipient pattern of countries along the Belt and Road and the future path of foreign aid transformation of developed countries.

3.3.2 Globalization and the community of common destiny for humankind

The world is witnessing its third wave of economic globalization and entering the 3.0 era of economic globalization. Social, economic, cultural, technological, and ecological globalization trends are diverse, and are the concentrated reflection of the response of neoliberal capitalism to globalization. In addition, changes in global geopolitical patterns affect the territorial security, economic security, resource security, and ecological security of all countries. In recent years, research in this field has mainly focused on regional cooperation and regional economic integration (Amin, 2010); the influence of transnational corporations and foreign investment on industrial agglomeration and regional development patterns (Shin *et al.*, 2017); the structural contradictions and debt crisis, and the theory of the community of common destiny for humankind. Essential research results have been gained. Under the influence of transnational corporations, debts and other products born out of globalization in less developed countries, as well as the tensions and trade-offs between the ecological environment and sustainable development in those countries, are becoming increasingly acute. Relevant research mainly involves the impact of globalization on regional trade and regional patterns in less developed countries or regions; the trade control of multinational corporations in developed countries over less developed countries or regions under the globalization of monopoly capital (Foster, 2015); the evolution trend of the debt crisis and its impact on less developed countries or regions (Aizenman *et al*., 2016); the shaping of industrial development by globalization, and the resource pattern of regional community and the cooperative development mode.

4 Objective function measurements and applications of development geography

Development geography measures the level of development convergence of a country and region by development indicators, which include both qualitative and quantitative components (Table 2). In the mid-20th century, qualitative methods, such as comparative analysis, observation and description, and theoretical discussion, as well as quantitative methods, such as statistics and linear analysis, were rapidly developed. Since the 1960s, studies have typically used quantitative indicators, such as gross national product per capita and unemployment rates, to measure economic growth and social development. Gould (1963) pointed out that a cognitive process is the objective product of a stimulus imposed by the environment on an individual, and proposed the “zero-sum game” method to pursue the minimization of risk loss. In the 1970s, the Physical Quality of Life Index (PQLI) was developed by the U.S. Overseas Development Council to measure the material well-being of less developed countries and regions. In the 1980s, influenced by humanistic ideologies (Couclelis,

1983), development geography introduced a new wave of psychoanalytic approaches to research. The Human Development Index (HDI) was introduced by the United Nations Development Programme (UNDP) in 1989 to measure economic and social development levels. By the 1990s, with the advancements in development geography, scholars gradually recognized the relevance of non-economic factors to the development process. There has been an increase in the use of quantitative methods in the field of development, including the use of systems science, operations research, and metrology, to reveal the spatial patterns of interconnections and interactions among human phenomena. Saaty (1994), an American operations research expert, proposed analytic hierarchy process that combines qualitative and quantitative analytic method, which partially reduces the influence of subjective factors, and has been widely used and developed in related fields. The concept of "human-oriented" as a progressive means of achieving development has contributed to the development of feminism and has humanized the study of development geography. The advent of remote sensing technology has improved the accuracy of data collection and developmental characteristic index processing. Lowe (2004) introduced scale-invariant feature transformation (SITF) methods and improved them, resulting in improved geo-alignment techniques.

Table 2 Indicators to measure the level of development convergence in development geography

	Indicator	Utility
Quantitative indicator	Economic indicators: Gini coefficient, gross national product (GNP) per capita, unemployment rate, energy consumption, share of primary sector	Used to measure the level and balance of socio-economic development of a country
	Social indicators: clean water and sanitation, adult literacy rate	Used to measure whether the country is meeting the needs of people
	Demographic indicators: birth rate, mortality rate, fertility rate	Used to measure the country's level of social development
	Composite indicators: gross domestic product (GDP), Physical Quality of Life Index (PQLI), Human Poverty Index (HPI), Gender-Related Development Index (GDI)	Comprehensive measurement of whether the country is improving the quality and standard of life of people
Qualitative Index	Indicators that include non-material benefits such as freedoms, rights, and security.	Used to analyze indicators that are not easy to calculate or measure

The research content of development geography covers a wide range and a large amount of data, so accurate data analysis, model construction, and visualization have become vital in understanding objective laws and providing decision-making services. In recent years, analytical tools, such as night-time light data analysis, statistical analysis, and big-data mining have been rapidly developed and applied (Sharma, 2016), and advances in Geographic Information Systems (GISs) and remote sensing technology have provided technical support for the development geography of spatial analysis and spatial planning (Jin *et al*., 2019a). The combined use of qualitative and quantitative methods can help development geographers strengthen their knowledge of sustainable development and regional balanced development issues and development patterns in less developed countries or regions. Recently, development geography has utilized new research methods, including spatial analysis and model simulation, evaluation and prediction based on GIS technology, cloud computing, big-data internet technology, social-network analysis, input-output methods, and computable general equilibrium (CGE) methods (Li *et al*., 2019). Spatial analysis, model simulation and visualization based on GIS technologies have significantly improved the ability to analyze

the evolution of spatial patterns. For example, the methods of 3S technology have been widely used in such research fields as regional resource carrying capacity simulation, industrial development and industrial layout, and the vulnerability assessment of socio-economic systems in the changing environment of the Belt and Road countries. This provides a strong technical basis for promoting green development in less developed countries and regions.

In the current era of the internet and technological change, innovation technologies, such as big-data, visualization, and virtual reality provide key support for studying development geography related issues. 1) To construct new models of poverty alleviation based on big data and internet technology and establish a dynamic monitoring mechanism for poverty alleviation management to improve the accuracy of poverty identification (Chen, 2018). 2) By identifying hotspots of population spatial mobility, technologies are applied to provide a scientific basis for industrial layout, so as to accelerate exploration of the research paradigms, methods, and content of development geography. 3) To use social-network analysis to identify the core nodes, important relationships, and regional agglomeration effects of different network organization types in cluster networks of underdeveloped agricultural areas. 4) To increasingly apply input-output methods to regional and even global trade analysis, cross-country production, and the environmental effects of changes in trade value added and globalized trade. 5) Based on the general equilibrium theory and the interaction between environment and economic system, to use the environmental CGE model to comprehensively study the relationship between environmental conservation and economic growth and provide a technical basis for policy formulation and evaluation. In addition, the integration of the disciplines of development economics, management science, and ecology realized the goal of environmental management and industrial optimization in less developed countries and regions—this achievement has been on addressing regional industrial backwardness, and environmental constraints.

5 Expansion of development geography research

Through continuous innovation and development, much has been achieved in development geography theory, with its theoretical construction now impressively robust. However, in regional development, how to identify convergence in the development of underdeveloped regions and in the improvement in quality of life in developed regions using geography is still a major challenge in the context of globalization and sustainable development (Xu, 2013). Previously, development geography has focused on the social development history of underdeveloped countries and regions, examining problems concerning their social and economic development. Now, it is imperative to rethink the discourse power and geopolitical nature of development geography and to analyze ways to exercise political and economic power based on development ideas. However, specific climatic environments, weak political and economic systems, lack of educational conditions, trade protectionism barriers, and unequal wealth distribution in underdeveloped countries and regions hinder the balanced development of their social economies. Cultural barriers to development, such as discrimination based on gender, race, religion, and sexual orientation, are difficult to address. Human poverty, particularly chronic poverty, and resulting hunger and illiteracy, pandemics, environmental degradation, discrimination against women, and dependence on existing devel-

opment assistance mechanisms constitute global challenges to human development. While these obstacles to economic growth and development are most common in the world's less developed economies, even the most developed economies suffer from specific development obstacles, such as drugs and income inequality (Blanc, 2015).

The structure and direction of development geography research topics reflect important contemporary development issues, and in the future, the research field of development geography will be broadened. Development paths, urban and industrial change, and rural livelihood pattern selection in underdeveloped countries, as well as convergence in the process of improving the quality of life in developed countries, are still important areas of development geography research (Mark, 2020). In addition, research on poverty and poverty reduction, land-space planning and industrial policy, climate change and regional response, ecological and environmental management and sustainable development, and world geography and the geopolitical economy—against the background of globalization—are now prominent topics in development geography. With improvements in geographic information technology and internet technology, model simulation, geo-computation, big data, and GIS, analyzing development problems and creating the next generation of research has become easier and more sophisticated. In the future, research will expand, and its inherent methods are almost certain to improve constantly. Humanization, socialization, and technicalization will become the most important areas of research in development geography, providing a theoretical basis for the sustainable development of social economies in underdeveloped countries and regions.

During the large-scale and rapid urbanization of China, as urban and rural development imbalance and environmental pollution problems worsened, the study of development geography arose and developed gradually (Jin *et al.*, 2019b). With the efforts of the Geographical Society of China and other academic organizations, the Working Group on Industrial Policy and Development Geography of the Geographical Society of China was established in 2015. Annual academic conferences on the industrial policy and development geography of China have been held in Beijing, Wuhan, Jinan, and Yinchuan. In a spirit of "exchange and dialogue," the academic conference discussed various issues arising in development geography research. The conference provides a platform for domestic scholars to exchange experiences, present scientific research, and broaden the horizon of scientific research. The conference enhances China's development geography, serves national and local constructions with the latest research and scientific methods, promotes the implementation of SDGs, and facilitates interdisciplinary research. In addition, applications in geography, economics, management science, and environmental science are discussed.

6 Some thoughts on promoting development geography research in China

Based on the five development concepts of "innovation, harmonization, green, openness, and sharing", China currently uses major national development strategies such as the Belt and Road Initiative, ecological civilization construction, new urbanization, and rural revitalization as a powerful starting point. China has made significant attempts to solve the major social problems inherent to unbalanced and inadequate development and to improve people's quality of life. This has led to a complete national development plan, with the aim of establishing a moderately prosperous society, of achieving long-range objectives set for

2035 in stages, and finally, of taking advantage of China's rapid development to ensure a prosperous future for humankind. Development geography is a subject that can be used for practical purposes. The field urgently needs to be oriented to serve the major strategic needs of the country, integrating the natural and social sciences, to decide on key issues and effective measures, to enhance socioeconomic development, and to address national economic construction and social development (Rockstrom, 2016).

With the rapid development of economic globalization and informatization, the acceleration of China's urbanization, industrialization, and modernization has changed its economic and ecological environments in various regions (Bruno *et al*., 2000). The economy of China presents characteristics of slower growth, better structure, and power conversion. The core issues of development geography research in promoting economic transformation are how to accelerate green development and ecological civilization construction, how to eliminate poverty, how to realize the coordinated sustainable development of a region, and finally, how to find a scientific development path with Chinese characteristics. There is an urgent need for strong support for innovative development geography research. Moreover, the relation between rapid economic growth and development issues in underdeveloped countries and regions urgently requires in-depth analysis.

Under the new situation of promoting industrial transformation and building an ecological civilization system and beautiful China, development in China requires scientific guidance of development geography with Chinese characteristics. However, theoretical research in development geography, with Chinese characteristics, has lagged behind practical experiment for a considerable time, and has not yet formed a scientific research paradigm oriented to the major needs of national development. It is difficult to provide path selection and coping strategies for national needs. In this regard, China should learn from and absorb foreign experience, learning lessons in solving social development problems during rapid development. China should formulate development policies in accordance with its needs, arising from rapid development of the regional economy. Meeting national strategic needs and regional coordinated development needs, China's innovative development geography research will face many complex challenges (Jin *et al*., 2018). Here, in response to the latest trends in international academic research, and the major needs of the country's macroeconomic policymaking, there are four directions of China's development geography research that should be focused on (Mawdsley, 2018).

(1) Building a theoretical framework for the development of geography in China. Development geography research in China began relatively late, resulting in its depth and breadth differing substantially from that of other countries; its theoretical framework and method system need to be greatly improved. However, China's reality, which is different from that of the West, provides a diversified research direction for its own development (Roorbach, 1912). It is necessary to expand the theoretical framework of development geography based on regional development policy assessment theory. From the perspective of development geography, it is necessary to expand the theoretical framework of development geography, which is based on regional development policy assessment theory, frontier theory of industrial space development and regional economic coordinated development.

(2) Building an interdisciplinary integrated system and conducting applied research. The essential characteristic of geography is comprehensive, which makes geographic research

acquire lots of great achievements combined with the achievements made in development geography, strengthening interdisciplinary integrated research will further promote the integration of different disciplines. This will help us explore the development problems and development methods of less developed countries and regions in depth, providing a more scientific way to solve any new problems emerging in the development process. In addition, earth-observation technology and space-time resolution technology are becoming more and more mature in the information era, and various new technologies are emerging. These technologies provide scientific and technological means for the development of multi-scale, multi-temporal, and spatial research in development geography. Problems in the development process will be quantified, to build a new platform for regional development.

(3) Exploring the new model of regional green development and ecological civilization construction. Against the background of new urbanization, not only do we need economic development but a clean environment. Regional green development and ecological civilization construction will become important issues in development geography, they are also urgent areas to deepen the research on promoting regional coordination and sustainable development. Several points need to be focused on the following. Firstly, exploring the new model of coordinated coupling of regional population and economy, and urban and rural areas and ecology when improving the quality of life in less developed regions. Secondly, focusing on the sensitivity and vulnerability of regional ecological environments, promoting regional industrial development, and optimizing the framework of territorial space, according to local conditions. Thirdly, actively addressing the risks brought about by climate change, so as to strengthening ecological environmental management and sustainable development. Fourthly, exploring the relationship between territorial space ecological restoration and new human-land relations, to stimulate the development potential of less developed regions and promote regional coordinated development.

(4) Exploring the new path of China's industrial policy transformation under the new situation. As China's economic development enters the "new normal," to address the major scientific problems and practical issues of the patterns and characteristics of China's industrial development, an optimal allocation of resources in the process of green transformation is needed, and a policy guarantee mechanism of industrial transformation and innovation requires implementation. This will provide the necessary scientific and technological support and decision-making advice for the realization of the regional green development strategy, as well as the construction of a community with a shared future for mankind. The development and transformation of industry requires supporting assistance, through combing the spatial pattern and regional differences of industrial developments in less developed regions. A systematic analysis should be conducted on the development mechanism and leading elements of industrial policy transformation in less developed regions; industrial policy objectives require adjustment in a timely manner, and different regional models and scientific paths are needed to promote sustainable development (Deng *et al*., 2020).

References

Aizenman J, Jinjarak Y, Lee M *et al*., 2016. Developing countries' financial vulnerability to the eurozone crisis: An event study of equity and bond markets. *Journal of Economic Policy Reform*, 19(1): 1–19.

Amin A, 2010. An institutionalist perspective on regional economic development. *International Journal of Urban*

and Regional Research, 23(2): 365–378.
Ansell N, 2016. Children, Youth, and Development. London and New York: Routledge.
Arora B, Puranik R, 2004. A review of corporate social responsibility in India. *Development*, 47(3): 93–100.
Babcicky P, 2013. Rethinking the foundations of sustainability measurement: The limitations of the environmental sustainability index (ESI). *Social Indicators Research*, 113(1): 133–157.
Bandelj N, Morgan P J, 2015. Culture and economy. *International Encyclopedia of the Social and Behavioral Sciences*, 41(6): 535–541.
Barnes T J, 2001. Retheorizing economic geography: From the quantitative revolution to the "cultural turn". *Annals of the Association of American Geographers*, 91(3): 546–565.
Bauer B O, 1996. Geomorphology, geography, and science. *Scientific Nature of Geomorphology*, 381–413.
Bebbington A, 2003. Global networks and local developments: Agendas for development geography. *Tijdschrift Voor Economische en Sociale Geografie*, 94(3): 297–309.
Blanc L, David, 2015. Towards integration at last? The sustainable development goals as a network of targets. *Sustainable Development*, 23(3): 176–187.
Bruno M, Martin G, Thomas H *et al*., 2000. From nature-dominated to human-dominated environmental changes. *Quaternary Science Reviews*, 19(1): 459–479.
Bryceson D F, 2002. The scramble in Africa: Reorienting rural livelihoods. *World Development*, 30(5): 725–739.
Chant S H, McIlwaine C, 2009. Geographies of Development in the 21st Century: An Introduction to the Global South. Cheltenham: Edward Elgar Publishing.
Chen L, 2018. Poverty alleviation of "smart countryside": An empirical study on mechanism, innovation model and guarantee systems. *Iop Conference*, 185.
Cheng L K, 2016. Three questions on China's "Belt and Road Initiative". *China Economic Review*, 40: 309–313.
Choudhury A, Aron S, Botigue L R *et al*., 2020. High-depth African genomes inform human migration and health. *Nature*, 586(7831): 741–748.
Couclelis H, 1983. Analytic research, positivism, and behavioral geography. *Annals of the Association of American Geographers*, 73(3): 331–339.
Dawson N, Martin A, Sikor T, 2016. Green revolution in sub-Saharan Africa: Implications of imposed innovation for the wellbeing of rural smallholders. *World Development*, 78(2): 204–218.
Deng X, Jin G, He S *et al.*, 2020. Research progress and prospect on development geography. *Acta Geographica Sinica*, 75(2): 226–239. (in Chinese)
Desai V, Potter R B, 2013. The Companion to Development Studies. London and New York: Routledge.
Dickenson J, Dickenson J P, Gould B *et al*., 1996. A Geography of the Third World. London and New York: Routledge.
Dong Y, Jin G, Deng X, 2020. Dynamic interactive effects of urban land-use efficiency, industrial transformation, and carbon emissions. *Journal of Cleaner Production*, 270: 122547.
Dong Y, Jin G, Deng X *et al*., 2021. Multidimensional measurement of poverty and its spatio-temporal dynamics in China from the perspective of development geography. *Journal of Geographical Sciences*, 31(1): 130–148.
Edwards S, 1995. Crisis and Reform in Latin America: From Despair to Hope. Oxford: Oxford University Press.
Escobar A, 2011. Encountering Development: The Making and Unmaking of the Third World. Princeton: Princeton University Press.
Essex J, 2013. Development, Security, and Aid: Geopolitics and Geoeconomics at the US Agency for International Development. Georgia: University of Georgia Press.
Fernández R, 2014. Women's rights and development. *Journal of Economic Growth*, 19(1): 37–80.
Foster J B, 2015. The new imperialism of globalized monopoly-finance capital: An introduction. *Monthly Review*, 67(3): 1–22.
Gibson graham J K, 2002. Intervenciones posestructurales. *Revista Colombiana de Antropologia*, 38(1): 261–286.
Gould P R, 1963. Man against his environment: A game theoretic framework. *Annals of the Association of American Geographers*, 53(3): 290–297.
Gunder F A, 1978. Dependent Accumulation and Underdevelopment. London: Palgrave Macmillan.
Guo B, He D, Zhao X *et al.*, 2020. Analysis on the spatiotemporal patterns and driving mechanisms of China's agricultural production efficiency from 2000 to 2015. *Physics and Chemistry of the Earth*, 120: 102909.
Haan L D, Zoomers A, 2003. Development geography at the crossroads of livelihood and globalisation. *Tijdschrift*

voor Economische en Sociale Geografie, 94(3): 350–362.
Harvey D, 1975. The geography of capitalist accumulation: A reconstruction of the Marxian theory. *Antipode*, 7(2): 9–21.
Henderson J V, Shalizi Z, VenabGles A J, 2001. Geography and development. *Journal of Economic Geography*, 1(1): 81–105.
Hodder R, 2005. Development Geography. London and New York: Routledge.
Hudson R, 2016. Rising powers and the drivers of uneven global development. *Area Development and Policy*, 1(3): 279–294.
Jarrett K, 2014. The relevance of "women's work" social reproduction and immaterial labor in digital media. *Television and New Media*, 15(1): 14–29.
Jayachandran S, 2015. The roots of gender inequality in developing countries. *Economics*, 7(1): 63–88.
Jin G, Chen K, Wang P *et al.*, 2019a. Trade-offs in land-use competition and sustainable land development in the North China Plain. *Technological Forecasting & Social Change*, 141: 36–46.
Jin G, Deng X, Zhao X *et al*., 2018. Spatiotemporal patterns in urbanization efficiency within the Yangtze River Economic Belt between 2005 and 2014. *Journal of Geographical Sciences*, 28(8): 1113–1126.
Jin G, Guo B, Deng X, 2019b. Is there a decoupling relationship between CO_2 emission reduction and poverty alleviation in China? *Technological Forecasting & Social Change*, 151: 119856.
Jin G, Shi X, Zhang L *et al*., 2020. Measuring the SCCs of different Chinese regions under future scenarios. *Renewable & Sustainable Energy Reviews*, 130: 109949.
Kanbur R, Sumner A, 2012. Poor countries or poor people? Development assistance and the new geography of global poverty. *Journal of International Development*, 24(6): 686–695.
Kelly P F, 2010. Everyday urbanization: The social dynamics of development in Manila's extended metropolitan region. *International Journal of Urban and Regional Research*, 23(2): 283–303.
Khalil H A E, 2012. Enhancing quality of life through strategic urban planning. *Sustainable Cities and Society*, 5: 77–86.
Kothari E B U, 2016. A Radical History of Development Studies: Individuals, Institutions, and Ideologies. London: Zed Books Ltd.
Kušková P G, 2013. A case study of the Czech agriculture since 1918 in a socio-metabolic perspective: From land reform through nationalisation to privatisation. *Land Use Policy*, 30(1): 592–603.
Lahiff E, Cousins B, 2010. Smallholder agriculture and land reform in South Africa. *IDS Bulletin*, 36(2): 127–131.
Lawson V A, 2007. Making Development Geography. London and New York: Routledge.
Leemans R, De Groot R S, 2003. Millennium Ecosystem Assessment: Ecosystems and Human Well-being: A Framework for Assessment. London: Island Press.
Leite I C, Pomeroy M, Suyama B, 2015. Brazilian south-south development cooperation: The case of the ministry of social development in Africa. *Journal of International Development*, 27(8): 1446–1461.
Li G, Cai Z, Liu J *et al*., 2019. Multidimensional poverty in rural China: Indicators, spatiotemporal patterns and applications. *Social Indicators Research*, 144(3): 1099–1134.
Li X, Yang Y, Liu Y *et al*., 2017. Research progress in man-land relationship evolution and its resource-environment base in China. *Journal of Geographical Sciences*, 27(8): 899–924.
Lowe D G, 2004. Distinctive image features from scale invariant key points. *International Journal of Computer Vision*, 60(2): 91–110.
Mark D Partridge, Dan S Rickman, 2008. Distance from urban agglomeration economies and rural poverty. *Journal of Regional Science*, 48(2): 285–310.
Mark Pelling, 2020. Aadel Brun Tschudi Annual Lecture 2017-efficiency and equity in development geography, the SDGs and the Sendai Framework. *Norsk Geografisk Tidsskrift-Norwegian Journal of Geography*, 74(1): 5–12.
Martin N, Rice J, 2014. Sustainable development pathways: Determining socially constructed visions for cities. *Sustainable Development*, 22(6): 391–403.
Mawdsley E, 2012. The changing geographies of foreign aid and development cooperation: Contributions from gift theory. *Transactions of the Institute of British Geographers*, 37(2): 256–272.
Mawdsley E, 2018. Development geography II: Financialization. *Progress in Human Geography*, 42(2): 264–274.
Moseley W G, Carney J, Becker L, 2010. Neoliberal policy, rural livelihoods, and urban food security in West

Africa: A comparative study of The Gambia, Côte d'Ivoire, and Mali. *Proceedings of the National Academy of Sciences*, 107(13): 5774–5779.

Myrdal G, 1957. Economic Theory and Underdeveloped Regions. London: Duckworth.

Nesar A, Edwardh A, Jamesf M, 2010. Using the sustainable livelihoods framework to identify constraints and opportunities to the development of freshwater prawn farming in Southwest Bangladesh. *Journal of the World Aquaculture Society*, 39(5): 598–611.

Nissing C, Blottnitz H V, 2010. Renewable energy for sustainable urban development: Redefining the concept of energisation. *Energy Policy*, 38(5): 2179–2187.

Oliver M, Sapey B, Thomas P, 2012. Social Work with Disabled People. London: Palgrave Macmillan.

Pittaway E, Bartolomei L, Hugman R, 2010. 'Stop stealing our stories': The ethics of research with vulnerable groups. *Journal of Human Rights Practice*, 2(2): 229–251.

Potter R, Binns T, Elliott J A *et al*., 2017. Geographies of Development: An Introduction to Development Studies. London and New York: Routledge.

Potter R, Conway D, Evans R *et al.*, 2012. Key Concepts in Development Geography. London: Sage Publications.

Power M, Sidaway J D, 2004a. The degeneration of tropical geography. *Annals of the Association of American Geographers*, 94(3): 585–601.

Power M, 2004b. Rethinking Development Geographies. London and New York: Routledge.

Ran L, 2017. An empirical study on the promotion of contemporary international trade innovation and network trade to China "the Belt and Road" development strategy. *Boletín Técnico*, 55(6): 335–343.

Razavi S, 2016. The 2030 Agenda: Challenges of implementation to attain gender equality and women's rights. *Gender and Development*, 24(1): 25–41.

Reid A, Brooks J, Dolgova L *et al.*, 2017. Post-2015 sustainable development goals still neglecting their environmental roots in the Anthropocene. *Environmental Science & Policy*, 77: 179–184.

Riebsame W E, Meyre W B, Turner B I, 1994. Modeling land-use and cover as part of global environmental-change. *Climatic Change*, 28(1/2): 45–64.

Rockstrom J, 2016. Future earth. *Science*, 351(6271): 319–319.

Roorbach G B, 1912. China: Geography and resources. *The Annals of the American Academy of Political and Social Science*, 39(1): 130–153.

Saaty T L, 1994. How to make a decision: The analytic hierarchy process. *European Journal of Operational Research*, 48(1): 9–26.

Sallu S M, Twyman C, Stringer L C, 2010. Resilient or vulnerable livelihoods? Assessing livelihood dynamics and trajectories in rural Botswana. *Ecology and Society*, 15(4): 299–305.

Sharma R C, Tateishi R, Hara K *et al*., 2016. Global mapping of urban built-up areas of year 2014 by combining MODIS multispectral data with VIIRS nighttime light data. *International Journal of Digital Earth*, 9(10): 1004–1020.

Shin J, Mendoza X, Hawkins M A *et al.*, 2017. The relationship between multinationality and performance: Knowledge-intensive vs. capital-intensive service micro-multinational enterprises. *International Business Review*, 26(5): 867–880.

Shrestha LB, 2000. Population aging in developing countries. *Health Affairs*, 19(3): 204–212.

Todaro M P, 1982. Economics for a Developing World: An Introduction to Principles, Problems and Policies for Development. Harlow Essex: Prentice Education Limited.

Turkoglu H, 2015. Sustainable development and quality of urban life. *Procedia-Social and Behavioral Science*s, 202: 10–14.

United Nations, 2015. The Millennium Development Goals Report 2015. United Nations Publications.

Wang Y, Chen Y, Chi Y *et al*., 2018. Village-level multidimensional poverty measurement in China: Where and how. *Journal of Geographical Sciences*, 28(10): 1444–1466.

Willis K, 2011. Theories and Practices of Development. London and New York: Routledge.

Wise R D, Covarrubias H M, Puentes R, 2013. Reframing the debate on migration, development and human rights. *International Journal of Population Geography*, 19(4): 430–443.

Xi B, Li X, Gao J *et al.*, 2015. Review of challenges and strategies for balanced urban-rural environmental protection in China. *Frontiers of Environmental Science and Engineering*, 9(3): 371–384.

Xu G, Ge Q, Gong P *et al*., 2013. Societal response to challenges of global change and human sustainable development. *Science Bulletin*, 58(25): 3161–3168.