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ORIGINAL RESEARCH ARTICLE

Goal orientation and action path of eco city cluster construction

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ABSTRACT

Eco urban agglomeration is a highly harmonious compound ecosystem between man and nature, and a highly cooperative regional environmental community among environmental actors. The goal of eco city cluster construction is to optimize the overall function of regional ecosystem, improve the service quality of ecosystem, and form a highly unified urban aggregate of ecological space, ecological environment, ecological economy and ecological society. The action path of eco urban agglomeration construction is to innovate the system and mechanism of regional environmental governance, realize the cooperative governance of urban agglomeration environment, realize the coordination and connection of policy planning, regional environmental legislation cooperation and environmental supervision and management cooperation. Coordinate the management of the ecosystem of urban agglomerations, promote the construction of ecological functional areas of urban agglomerations, optimize the ecological spatial structure of urban agglomerations, and adhere to the ecological red line of urban agglomerations. By planning ecological cities and developing ecological economy, multiple subjects jointly promote the construction of ecological cities in urban agglomerations.

Keywords: ecological urban agglomeration; goal orientation; action path

1. Introduction

Urban agglomeration is the core area of national, regional and even global economic and social development. It is an area with highly intensive population and economic activities, a highly concentrated area of resource consumption, and an area with highly concentrated and most complex ecological and environmental problems. At present, China's urbanization and urban agglomerations are developing rapidly, but the contradiction between the production and living ecological space of cities and urban agglomerations is becoming increasingly prominent, and the ecological environment presents an overall deterioration trend. How to coordinate the relationship between human activities and natural environment of urban agglomerations, solve the increasingly severe ecological and environmental problems of urban agglomerations and promote the sustainable development of urban agglomerations has become the main challenge facing the development of urban agglomerations in China. Relying solely on the promotion of eco city construction, it is difficult to deal with the overall, cross-border and complex regional public environmental problems. It is necessary to realize the regional environmental cooperative governance of urban agglomeration. The construction of

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eco city agglomeration is a rational choice for regional environmental governance.

2. Ideological connotation of eco city cluster

In 1971, the "man and biosphere" program of UNESCO first proposed the new concept and development model of "eco city". The program pointed out that eco city needs to create an optimal environment for human activities integrating human technology and natural ecology. Professor William Reese, a master of ecology, regards the city as an ecosystem. He believes that the operation of the city should comply with the ecological principles and coordinate with the nature. The ecological city should minimize the ecological burden of the region, rely on the urban ecosystem itself to maintain the operation of the city and reduce the dependence on the external ecosystem of the city[1]. Ecologist white believes that eco cities can provide acceptable living standards for residents without exhausting the ecosystem that humans rely on and destroying the biogeochemical cycle[2]. Eco city is a new urban form with a high degree of integration of urban living environment and natural environment and a high degree of integration of urban production and living ecological space. The 2002 Johannesburg World Summit on sustainable development took eco city planning as a specific action strategy for governments to promote urban sustainable development. Therefore, eco city construction was widely implemented all over the world. In 2003, China's former State Environmental Protection Administration published the construction index of Ecological County, ecological city and ecological province (for Trial Implementation), guiding the establishment of Ecological County, ecological city and ecological province throughout the country At present, more than 20 cities in China have put forward the goal of promoting the construction of ecological cities.

Urban agglomerations are more complex organisms than cities and have natural ecological attributes. From the perspective of ecology, the relationship between different cities in the same regional ecological environment is the same as that between different organisms or species. They are all ecological relationships[3]. Hornachevsky, an American scholar, first put forward the concept of "ecological orientation". He stressed that regional ecological value and ecological service function should be combined with land development and Utilization Policies to guide regional development through "ecological optimization" and "ecological orientation"[4]. In 2004, Guangdong Province first put forward the idea of building an ecological urban agglomeration in the outline of environmental protection planning of the Pearl River Delta, which proposes to take the lead in building a national ecological urban agglomeration in the Pearl River Delta by 2020. Introducing the concept of ecological urban agglomeration into the environmental governance of urban agglomeration is the promotion and development of the idea of ecological civilization. From eco city construction to eco city cluster construction is a new thinking of regional environmental governance and an inherent requirement and inevitable choice for the sustainable development of urban agglomeration. Professor Fang regards ecological urban agglomeration as a new construction mode of urban agglomeration and the most ideal and highest development mode of urban agglomeration pursued by mankind[5]. He believes that ecological urban agglomeration is a highly harmonious and unified complex ecosystem of society, economy, culture and nature Professor Dong also believes that the ecological urban agglomeration model is an urban agglomeration development model that reasonably allocates urban agglomeration resources according to the idea of sustainable development, integrates the city with nature, and adapts to the regional ecological environment capacity and resource carrying capacity[6]. In short, eco city cluster refers to an urban area composed of several eco cities of different grades and sizes, with reasonable ecological spatial structure, good natural ecological environment, healthy development of ecological economy and popularization of ecological production and life. Eco city cluster is a highly harmonious compound ecosystem between man and nature and a highly cooperative regional environmental

community among environmental actors. The core characteristics of eco urban agglomeration include two aspects.

2.1. Eco urban agglomeration is a complex ecosystem

From the perspective of ecology and system theory, urban agglomeration is not only a natural ecosystem, but also a large biological cycle system composed of multi-agent, multi-level and multi factors with complex relationship among nature, economy and society [7]. The exchange of material, energy and information between cities, the externality of production and living activities and the competitiveness of economic and social development reflect an ecological relationship of mutual influence, interaction and interdependence, just like the ecological relationship between organisms in nature. From the perspective of ecology, the water environment, atmospheric environment, soil environment and other aspects in the urban group area affect and interact with each other, and it is an integral and regional natural ecosystem. There are economic, social and ecological development relationships among cities, and there are ecological links such as symbiosis and common prosperity of population, resources and environmentsymbiosis is a common phenomenon in nature and human society. Any city must know how to achieve coexistence and common prosperity with other cities in the urban agglomeration, so that the production, life and ecology of the urban agglomeration are in an optimized combination state of coordinated development. The complex ecosystem of urban agglomeration includes three subsystems: “eco-environmental system”, “eco-economic system” and “eco-social system”. Each subsystem affects, interacts and complements each other. Among them, eco-environmental system is the foundation, eco-economic system is the core, eco-social system is the guarantee, and each subsystem is divided into secondary subsystems at different levels[8]. Strictly speaking, eco urban agglomeration is not a geographical area artificially delimited according to the administrative boundary, but is divided according to the regional ecosystem. Ecological demarcation takes the integrity of ecosystem as the boundary, and ecological demarcation reflects the specific ecological region[9].

2.2. Eco city cluster is a regional environmental community

Thomas Bailey, a famous ecologist, believes that our era is an ecological era and is moving towards an “ecological era”. In this ecological period, human beings will live in a broad life community and in a mutually reinforcing relationship[10]. From the perspective of natural ecological characteristics, urban agglomerations basically belong to the same natural ecological system. For example, the Yangtze River Delta and Pearl River Delta urban agglomerations are in the lower reaches of the Yangtze River and Pearl River Basins respectively, belonging to the natural ecological system dominated by the accumulation of estuarine deltas. Beijing Tianjin Hebei urban agglomerations are in the Haihe River Basin, belonging to the natural ecological system formed by the accumulation of mountains and estuaries of Hutuo River and Haihe River. The ecological environment of urban groups has regional integrity, cross-border impact and relevance. Each city can not be beyond the impact of regional environment. Local governments are a community of common destiny Urban agglomerations and member cities, as well as member cities, are interdependent, and this dependence is manifested in that no one can be separated from others. Facing the increasingly prominent ecological and environmental problems of urban agglomerations, individual cities have limited resources and governance capacity. Individual cities cannot assume regional public environmental responsibility, and the split environmental governance model needs to be broken. Therefore, the environmental governance of urban agglomerations requires governments to form a responsibility community and action community, build an environmental community of urban agglomerations, concentrate the overall joint efforts of local governments, implement joint collective concerted action, give full play to the overall function of the community and promote the overall sustainable development of urban agglomerations.

The so-called environmental community of urban agglomeration is an urban consortium formed based on the integrity of regional ecological environment and the relevance of impact, based on the common interests of environmental protection, coordinated and cooperative governance of environmental public affairs among cities, and sharing ecological value and environmental value benefits[11]. The driving force of forming an environmental community of urban agglomeration is not only the value pursuit and interest orientation of regional good environment, but also the sharing of regional environmental responsibility. Therefore, the environmental community model is a rational choice for regional environmental governance actions and sustainable development.

3. Goal orientation of eco city cluster construction

Urban agglomeration is a composite system composed of natural system, economic system and social system. Ecological urban agglomerations do not simply pursue a good regional ecological environment, but take into account the harmonious and coordinated development of society, economy and environment. They not only pursue the goal of regional ecological environment, but also pursue the goal of ecological economic development and ecological social development[5]. It can be said that the goal of the construction of ecological urban agglomeration is to optimize the overall function of the ecosystem, improve the service quality of the ecosystem of urban agglomeration, enhance the carrying capacity of ecological environment, and form an urban aggregate with reasonable ecological spatial structure, safe ecological environment system, healthy ecological economic development and popularization of ecological social life (see **Figure 1**).

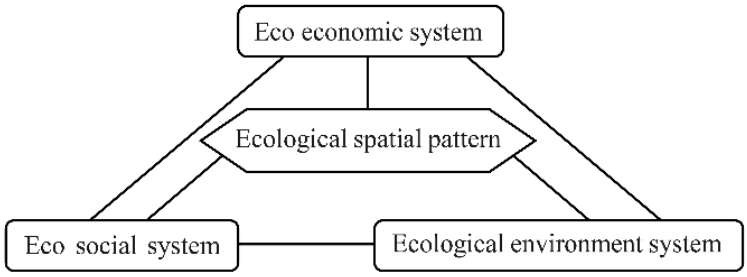

Figure 1. Organic structure of Ecological Urban Agglomeration.

3.1. Reasonable ecological spatial pattern

Ecological space is the physical space occupied by ecological elements and ecosystem structure. It includes both natural ecosystem and artificial ecosystem[12]. The ecological space of urban agglomeration reflects the development and utilization degree of natural resources and the ecological environment in the region, and reflects the composition and distribution of built space and ecological space in the region. Among them, the built-up space is the built-up area, which mainly refers to the urban area where urban residents produce and live[13]. In the national ecological function zoning, ecological space includes green ecological space and other ecological space, among which green ecological space includes forest land, wetland, natural grassland, water surface of reservoirs, rivers, lakes and other water bodies[14]. The ecological spatial pattern of urban agglomeration refers to the combination of physical space and geographical distribution characteristics occupied by the ecological basic system. Ecological infrastructure, also known as ecological infrastructure (EI), is the natural system and semi artificial system on which the sustainable development of urban agglomeration depends, and the basis for residents to obtain ecological services and sustainable economic and social development. Human production space and living space must rely on natural ecological space to provide ecological products or services. The ecological basic system of urban agglomeration mainly includes forest land (shrub land and other forest land),

green space (park green space, protective green space, production green space, auxiliary green space and other green space), water surface (water surface of rivers, lakes, reservoirs, pits and other water bodies), wetland (beach wetland, river wetland and other wetlands), garden (orchard, other garden land), cultivated land (farmland, irrigated land and other cultivated land), etc. These ecological basic systems make the ecosystem of urban agglomeration integrated and highly correlated within the system. From the perspective of ecological landscape, the components constituting the ecological spatial pattern are ecological base, ecological patch, ecological corridor, etc., which constitute the ecological network pattern of urban agglomeration[15]. Under the condition that the area and quality of the ecological functional area remain unchanged, the ecological infrastructure or ecological base, ecological patch and ecological corridor are optimized and reorganized to form an organic whole network, so as to improve the capacity and quality of the regional ecological environment of the urban agglomeration. The essential feature of ecological urban agglomeration is to improve the urban network system, reasonable division of labor among cities and towns, overall urban and rural development and coordinated industrial development in the urban agglomeration area on the basis of the interaction and symbiotic development between ecological spatial structure and economic and social development[16].

The rational ecological spatial pattern of urban agglomeration is mainly reflected in two points. The production and living space shall adapt to the natural ecological space. Production and living space and natural ecological space have relatively independent functions and clear boundaries. Although all ecological spaces have the function of production and living services, only the space with comprehensive ecological service function can become a living space. Only the ecological space with certain resource carrying capacity and environmental capacity can become the production space[17]. Therefore, in the urban agglomeration area, the production and living space of the city must adapt to the natural ecological space. We can't only pay attention to the needs of production and life, especially economic development, but sacrifice resources, environment and natural ecological space, resulting in ecological damage and environmental pollution. Therefore, it is necessary to optimize their spatial boundaries and functions, control the spread of urban production and life, and restore and expand ecological space or green space. The built-up area of urban agglomeration is coordinated with the ecological function area. In a broad sense, the built-up area of urban agglomeration refers to the relatively concentrated non-agricultural production and construction areas actually built or under construction, including the concentrated and contiguous urban areas, as well as other areas with basic municipal public facilities and public facilities scattered in the suburban areas[18]. Ecological functional areas mainly refer to areas that play an important role in water conservation, water and soil conservation, flood regulation and storage, wind prevention and sand fixation, and maintaining biodiversity, including water source protection areas, basic farmland protection areas, scenic spots, nature reserves, forests, public parks and other environmentally sensitive areas. These areas play an important role in maintaining the natural conditions and effectiveness of human survival, climate regulation, water regulation, water and waste purification, soil conservation, nutrient circulation and other important functions, which are related to the ecological security of urban agglomerations. On the one hand, their physical space is relatively independent; on the other hand, they integrate and complement each other. It is necessary to reasonably plan the development of built-up areas, limit the development of large-scale and high-intensity industrialization and urbanization, and prevent urban built-up areas from eroding the space of ecological functional areas. At the same time, it is also necessary to enhance the function of ecological functional areas and improve the supply capacity of ecological products[19].

3.2. Safe ecological environment system

In a broad sense, urban agglomeration ecosystem includes natural ecological environment system and social environment system. In a narrow sense, it

refers to natural environment system, i.e. ecological environment system. This ecological environment system is a unified whole composed of biological community and inorganic environment, including biological factors such as plants, animals, microorganisms, etc., and abiotic factors such as water, atmosphere, soil, etc. The core part of the eco-environmental system of urban agglomerations is the water environment, atmospheric environment and soil environment. These environments are the basic material environment for the survival of urban residents, and are also areas seriously disturbed and damaged by production and life. The pollution and destruction of these three environments have become the main challenges faced by today's urban agglomerations. Ecological security is a necessary condition for the economic and social development of urban agglomeration. The safety of the eco-environmental system of urban agglomeration is manifested in the health, stability and sustainability of the natural ecosystem-climate, water, air, soil and other ecosystems have self-regulation ability, which can maintain the integrity of the ecosystem, protect and restore biodiversity, effectively control regional ecological and environmental problems and continuously improve the regional spatial pattern[20]. From the perspective of ecology, the ecological security of urban agglomeration is mainly reflected in four aspects. Atmospheric environment safety. The atmospheric environment of urban agglomeration refers to the physical, chemical and biological characteristics of the air within the regionsuch as physical characteristics such as air temperature, humidity, air pressure and precipitation, and chemical components such as oxygen, nitrogen, hydrogen, carbon dioxide, ozone and water vapor. Almost every element of the atmospheric environment and its changes will affect the quality of the atmosphere, especially the harmful gases such as ammonia, sulfur dioxide, carbon monoxide, nitride and fluoride discharged from production and life will destroy the ecological balance and endanger human survival. Atmospheric environmental safety of urban agglomerations refers to that the atmospheric quality is maintained at an acceptable level or does not pose a threat and harm to the receiver. Water environment safety. Water environment refers to the distribution and quality of main water bodies in urban agglomerations, such as rivers, lakes, reservoirs, ponds and groundwater. Water environment security of urban agglomeration means that the water resources in the region can safely meet the sustainable utilization of water resources by all living and non living beings, and can achieve the dynamic balance of water resources supply and demand. Soil environment safety. Soil environment is an important part of the natural and geographical environment of urban agglomeration and the material basis for the sustainable economic and social development of urban agglomeration, especially the basis of regional agricultural production and green space ecosystem. Soil environmental safety of urban agglomeration refers to that the quantity, quality and structure of soil in the region are always in an effective supply state, that is, dynamically meet the needs of people's production and life in the region. Biological species safety. Biological species safety refers to the health and integrity of biological species in the region, that is, the environment on which various organisms rely for survival and development is not or less threatened and damaged by the outside, and organisms and their related ecological processes reach a balanced state to maintain species diversity.

3.3. Healthy eco economic system

Eco urban agglomeration is not only a natural geographical area, but also an economic geographical area. The economic system of urban agglomeration is a regional economic system with resource flow as the core and composed of economic activities such as production, exchange, distribution and consumption. The industrial structure, energy structure and transportation structure in the economic system determine the economic development quality of urban agglomeration and affect the environmental quality of urban agglomeration. The inherent requirement of eco urban agglomeration is to establish an ecological economic system and realize the ecology of the economic system. The so-called ecologization of economic system is to integrate the concept of ecology into economic activities and develop the

economy with the concept of ecology. Ecological economy has become the only way for the social and economic development of urban agglomeration. Ecological economy should pursue not only economic objectives, but also social equity and sustainable development, ecological security and sustainable utilization of resources. Ecological economy is an economic form based on the coordination of economic development and environmental protection and organized according to the mode of low-carbon development, circular development and green development. Low carbon development. The total amount of greenhouse gas emissions in urban agglomerations is large, the problem of air pollution is prominent, and low-carbon development is the inevitable economic development model low carbon development is mainly through popularizing low-carbon technology, developing low-carbon industry, innovating low-carbon management mode, changing energy consumption structure, establishing low-carbon industrial system, energy, transportation and other industrial systems and consumption modes, so as to realize the low-carbon economic development mode of social development[21]. For governments at all levels of urban agglomeration, it is necessary to strengthen low-carbon technology cooperation, low-carbon industry cooperation, low-carbon management mode cooperation, low-carbon policy docking, guide low-carbon production, low-carbon life and low-carbon consumption, and achieve low energy consumption, low emission and low pollution. Circular development. Circular development is an intensive economic growth mode. It adheres to the principles of reduction, reuse and recycling, promotes the circular link between production and living systems, and forms economic activities into a circular process of “resources - products - renewable resources”, to improve the utilization rate of resources and reduce resource consumption and environmental costs. Traditional economic growth depends on resource consumption, while circular economy realizes the good material circulation of economic system and natural ecosystem and maintains the natural ecological balance. Green development. In a broad sense, green development covers low-carbon development, circular development and other waysin a narrow sense, green development refers to the development mode based on “environmental priority and ecological orientation”, which is mainly reflected in green industry, green technology, green transportation, green policy and so on. Build a green industrial system and ecological industrial chain, promote ecological industry, vigorously develop ecological agriculture, and actively develop high-tech industry and modern service industry. Promote green production technology, actively guide enterprises to adopt green production technology and develop green production. Promote green transportation, plan, build and manage the transportation network and means of transportation of urban agglomeration according to the principles of natural ecology, human ecology and economic ecology, vigorously develop the public transportation of urban agglomeration and establish an ecological composite transportation system[22]. Governments at all levels of urban agglomerations guide and encourage social protection and regional environmental and ecological construction through green financial policies and green consumption policies.

3.4. Integrated eco social system

The construction of ecological urban agglomeration is affected not only by the natural environment and economic structure, but also by social culture, management system and other factors. The ecological concept of people in urban agglomeration has a direct or indirect impact on the ecological environment. Ecological humanistic system is the objective requirement to solve the contradiction between man and nature. Ecological and humanistic system is the core of ecological social system and the core component of ecological urban agglomeration. Humanistic and ecological environment is the cultural gene for building ecological urban agglomeration. Humanistic ecological environment is referred to as humanistic environment or cultural environment for short. Humanistic ecological environment is very extensive, including morality, culture, political environment, education, family culture, corporate culture, etc. Neville, an ecologist, put forward the idea of “overall

human ecosystem". The so-called total human ecosystem refers to the process of interaction between man and nature, with the deepening and deepening understanding of the natural ecological environment, seeking the most coordinated symbiotic model between man and earth, comprehensively reflecting the coordinated natural ecological ethics, sustainable production ethics and harmonious life ethics[23]. He highlighted that man and nature are integrated and equal ecological relations, and neither human nor natural ecology centered ecological ethics of man land coordination. As an urban development model facing the era of ecological civilization, ecological urban agglomeration not only needs to reconstruct the existing economic development model and spatial form, but also must promote the ecology of social system, especially to realize the ecology of social life and establish an overall symbiotic human ecosystem of urban agglomeration. The foundation of establishing this humanistic ecosystem is to advocate the ecological culture of integration and symbiosis. Ecological culture is a powerful spiritual driving force to promote the construction of ecological urban agglomeration, which can guide people to scientifically understand the laws of nature, consciously abide by the laws of nature, and coordinate the development of human social system and natural system. Ecological culture is an ecological concept that embodies ecological consciousness, ecological value, ecological ethics, ecological belief and ecological thinking. It is a social culture that reflects the harmonious development of nature, man and society. First, spiritual ecological culture, which is the core or deep structure of ecological culture. Spiritual ecological culture is manifested not only in the correct understanding of natural ecology and laws, economic, social and natural system ecology, but also in the awareness of ecological hardship and ecological responsibility based on the concept of ecological civilization and ecological belief. The second is behavioral ecological culture, which is reflected in human's production mode and life behavior of transforming nature and adapting to the environment, such as low-carbon and environmental protection lifestyle or consumption mode. Public ecological literacy is the cornerstone of ecological culture. Good ecological literacy can guide the public to respect nature, protect the environment and form a healthy and civilized way of life and consumption. The third is institutional ecological culture, which is mainly reflected in the ecological guidance of systems, policies, regulations and organizations in the social management system, and the establishment of environmental management system and mechanism of environmental friendliness and resource conservation.

4. Action path of eco city cluster construction

The construction of ecological urban agglomeration is a complex systematic project, which requires the coordinated action of governments in the region, the joint participation of all actors, the innovation of the institutional mechanism of regional environmental governance, the cooperative governance of regional environment and the joint management of regional ecosystem.

4.1. Realize environmental cooperative governance of Urban Agglomeration

The environmental problems of urban agglomerations are integrated, cross-border, complex and cumulative. The actions of individual cities cannot achieve the goal of governance, so we must take the road of intergovernmental cooperative governance of urban agglomerations. At present, the focus of urban agglomeration environmental cooperation is to establish a compound air pollution prevention and control system and a transboundary water pollution prevention and control system. To this end, governments must cooperate in decision-making, planning and supervision and management to innovate the regional environmental management system and mechanism of urban agglomeration.

Realize the coordination and connection of policies and plans

The most front-end of environmental governance cooperation of urban agglomeration is the government decision-making link, which first considers

the overall docking of regional environmental policy planning. The problem of disconnection between relevant environmental policies and planning in urban agglomerations is prominent, and it is necessary to realize the coordination and connection of policies, plans or plans that have a significant impact on the environment. The first is the connection of various plans in environmental policy. Urban agglomeration comprehensive development planning, main functional area planning, transportation development planning, environmental protection planning, land use planning, etc. must relate to each other to form a planning system based on main functional area planning and supported by relevant special planning. At the same time, according to the reality of urban agglomeration development, the layout of environmental functional areas and the development and utilization of ecological resources can be coordinated through the joint preparation of special atmospheric environment treatment plan, water environment treatment plan and soil environment treatment plan, as well as the joint preparation of regional environmental protection plan among neighboring governments. These plans take the ecological areas divided by natural boundaries rather than administrative divisions as the governance objects, and implement unified planning, unified design, unified standards and unified policies for regional environmental governance. Second, the inter governmental planning in the region is interconnected. For example, the contents related to and affecting the regional public environment in the inter governmental master plan for economic and social development, main functional area planning, urban development planning, environmental protection planning, transportation planning and land planning must be connected, and there can be no policy conflict on the same governance object. These plans need to relate to adjacent governments before submission for approval, to coordinate and connect the intergovernmental plans in the region. Third, major construction projects are discussed and approved. All projects that may bring cross regional environmental impact due to the construction at the boundary of the administrative region and important ecological function areas shall be determined by the neighboring government through consultation and approval. The local government of the project shall invite the neighboring government to participate, mainly territorial, consult the opinions of the neighboring government, exchange information and communicate with each other. Through the joint review, the environmental access threshold shall be controlled, and the environmental access of the boundary construction projects shall be strict to prevent cross-border transfer of pollution[24].

Strengthen regional environmental legislation cooperation

One of the obstacles to the environmental governance of urban agglomerations is that the environmental legislations of various places in the region are not unified, coordinated, or even conflict with each other. Regional cooperation legislation is an important way of regional environmental cooperation. Local people's congresses or governments in urban agglomerations can pass joint legislation to formulate regulations or regulations on regional environmental governance, reduce multiple legislation or duplicate legislation, and avoid legislative conflicts. For regional environmental legislation cooperation in urban agglomerations, a legislative coordination body can be established. The members of the body are composed of heads of regional legislative bodies and relevant legal experts to discuss regional environmental legislation projects through meetings and consultations[25]. To realize the unification of environmental legislation of urban agglomeration, on the premise of abiding by China's current legislative system, legislative cooperation can take the following two ways. First, it is jointly drafted and approved respectively. In view of the specific environmental problems in the urban agglomeration area, if it is considered that legislation is needed, it shall be jointly drafted by the regional legislative consultation institutions, or jointly drafted by the provincial governments or the legislative organs of the municipal districts in the urban agglomeration. After extensive coordination and joint demonstration, the mature draft shall be submitted to the provincial legis-

lative organs or the legislative organs of the municipal districts for voting and adoption. Second, independent legislation and sharing of legislative achievements. For regional environmental problems, if the legislation is generally targeted after the formulation and promulgation of relevant legislation in one place, there is no need to start a new stove in other places to discuss and demonstrate. It can be applied with slight modification based on unified basic contents, which can save the cost of legislation and, more importantly, reduce the contradictions and conflicts in environmental legislation[26].

Strengthen environmental supervision and management cooperation

Cooperation in environmental supervision and management of urban agglomeration is the central link of environmental cooperative governance, including intergovernmental joint monitoring, joint monitoring, environmental emergency cooperation, joint governance of regional transboundary rivers, etc. First, joint monitoring. All governments in the region or adjacent governments jointly formulate monitoring plans, determine monitoring points and monitoring standards, jointly build an integrated environmental monitoring network, establish a regional environmental monitoring database, jointly prepare regional environmental monitoring reports and release environmental information. For example, the air monitoring network of urban agglomeration jointly established by Guangdong, Hong Kong and Macao includes all monitoring stations in the Pearl River Delta into the regional air monitoring network. In addition, the urban agglomeration will improve the water quality monitoring of the river junction section across administrative regions, jointly establish an automatic water quality monitoring network, and strengthen the real-time monitoring of the transboundary water environment; Jointly establish an environmental quality monitoring network for hazardous and toxic substances to jointly monitor pollutants in urban agglomerations. Second, joint environmental monitoring. Governments in urban agglomerations regularly or irregularly carry out environmental joint inspection and environmental mutual inspection, timely eliminate cross-border environmental safety hazards, cooperate to crack down on environmental violations, and cooperate to deal with environmental emergencies. The main methods of joint environmental monitoring are joint law enforcement by adjacent governments and cross law enforcement by adjacent governments. The former requires the establishment of a joint law enforcement team across administrative regions. The latter is the way of cross supervision between adjacent governments to carry out cross law enforcement inspection on regional environmentally sensitive or vulnerable areas and adjacent heavily polluting enterprises, or exchange observers for supervision. Third, environmental emergency cooperation. Environmental pollution incidents in urban agglomerations need joint response from governments or multiple government departments due to their sudden, harmful and diffusive nature. Establish an environmental emergency response system for urban agglomerations, formulate joint emergency plans, formulate environmental risk management plans from regional, provincial and municipal levels, and establish a regional environmental emergency network with coordinated operation and rapid response.

Improve the environmental cooperation mechanism

First, the organizational mechanism of environmental cooperative governance. First, establish the Eco-environmental Protection Committee of urban agglomeration as the decision-making, supervision and coordination organization of regional environmental governance, which is mainly responsible for the formulation of regional environmental policies or plans; supervise the implementation of environmental laws and regulations and major environmental remediation activities; Coordinate conflicts on regional environmental issues; and study and solve major cross regional environmental problems, and put forward policy suggestions for major construction projects in the region. Secondly, establish a joint meeting on environmental governance. Through

joint meetings, governments can exchange information, eliminate differences, form consensus and promote joint action. In addition, special joint meetings such as energy conservation and emission reduction joint meeting and environmental emergency joint meeting can also be established. Second, the interest coordination mechanism of environmental cooperation. The environmental governance of urban agglomerations needs to reasonably share and distribute the costs and benefits in regional environmental governance cooperation, balance intergovernmental interest relations and realize the sharing of cooperation benefits. Based on the principle that cost allocation is relatively equal to income distribution, appropriate methods are used to share production costs and transaction costs. Based on the principles of clear rights and responsibilities, CO governance and sharing, the interests of environmental cooperation are basically divided to form a rule and mechanism for benefit sharing, so as to promote equal enjoyment of the achievements of environmental cooperation and regional development among cities Coordinate the Intergovernmental interest relations within the urban agglomeration through horizontal ecological compensation, environmental mutual fund, tax sharing, environmental tax collection and other ways[27]. Third, the information system of environmental cooperative governance. First, establish a database for environmental and environmental information sharing among governments (e.g. Regional environmental and environmental pollution sources), and realize the sharing of environmental and environmental information. Secondly, establish an intergovernmental environmental information notification system. Using Internet technology and communication technology, through holding joint meetings or academic conferences, prepare environmental briefings, exchange environmental governance information and exchange environmental governance experience. Fourth, intergovernmental environmental cooperation agreement. Environmental cooperation agreement is an important means of environmental cooperative governance. Through the cooperation agreement, the responsibilities, rights and interests of relevant subjects are determined to reduce the moral hazard of relevant parties, to better achieve the objectives of environmental management, such as intergovernmental ecological compensation agreement, emission trading agreement, cross-border river governance agreement, etc.

4.2. Strengthen ecosystem management of Urban Agglomeration

Ecosystem management refers to the management of maintaining the integrity of ecosystem components, structure and functions through the specific implementation of regional environmental policies and environmental cooperation agreements under the guidance of the goal of optimizing regional ecosystem service functions[28]. The focus of urban agglomeration ecosystem management is to build ecological functional areas and manage ecological space to maintain the ecological security of urban agglomeration.

Build an ecological functional area of urban agglomeration

The ecological function zoning of urban agglomerations is based on the national ecological function zoning and the national main functional area planning, and determines different ecological space units according to the continuity of ecological regions, the integrity of ecosystem functions, the sensitivity of ecological environment and the importance of ecological service functions. [29] The division of ecological functional areas of urban agglomerations emphasizes the integration of green space, forest land, garden land, cultivated land and wetland into the protection scope of ecological functional areas according to the natural ecological boundary rather than the administrative division boundary, and the overall integration into the ecological space planning system. The key to the construction of ecological functional areas of urban agglomeration is to strengthen the construction of key ecological functional areas and give priority to the protection of areas with high ecological importance (see **Table 1**). Key ecological functional areas include

important ecological spaces such as water conservation, water and soil conservation, wind and sand fixation and biodiversity maintenance, and areas that need to maintain and improve the supply capacity of ecological products such as nature reserves, drinking water source protection areas, water conservation areas, scenic spots, forest parks, wetland areas, public welfare forest lands, flood regulation and storage areas, river protection areas, etc. For these key ecological functional areas, adhere to ecological leadership and protection priority, carry out spatial integration and protection, strengthen ecological environment supervision and assessment, improve the environmental quality and environmental capacity of ecological functional areas, and enhance the production capacity of ecological products. Strictly control all kinds of development activities, reduce the space occupied by human activities and free up more space for maintaining the virtuous cycle of ecosystem[19].

Optimize the ecological spatial structure of urban agglomeration

The ecological spatial structure of urban agglomeration shows the spatial combination relationship of basic ecological elements such as ecological matrix, ecological patch and ecological corridor in urban agglomeration area. Optimizing the ecological space of urban agglomeration refers to integrating the ecological elements such as lakes, wetlands, forests, urban green space, farmland and scenic spots in the region through the reorganization of ecological matrix, ecological patches and ecological corridors in the urban agglomeration area (including the interior of the city), so as to form a reasonable, healthy and safe ecological framework and improve the capacity and quality of the ecological environment in the urban agglomeration area. Firstly, based on the "patch corridor matrix" theory of landscape ecology, identify and study the ecological sources, ecological corridors, ecological nodes and ecological matrix in the urban agglomeration area, and analyze the spatial distribution of the connection degree of regional ecological network[30]. Strengthen the protection of ecological patches, corridors and substrates, and strengthen the construction of road type and river type ecological corridors. Secondly, strengthen the ecological land planning of urban agglomeration, formulate the regional ecological land classification system, and build an ecological, compact, cluster and nested core area spatial structure. Clarify the location and boundary of "suitable construction area, restricted construction area and prohibited construction area", and select reasonable development mode and intensity for "suitable construction area"; strictly restrict construction and development activities in "restricted areas"; all construction and development activities shall be strictly prohibited in the "forbidden area". By controlling the non open space occupied by artificial buildings and structures in the built-up area, restore the ecological space eroded by production space, and optimize the production space and living space of urban agglomeration. Increase all kinds of urban green spaces such as garden, green space, agricultural land, forest land and grassland in the built-up area of urban agglomeration; protect and expand blue spaces such as lakes, rivers and wetlands, and maintain ecological integrity and service functions; waste land for mining and other ecological projects will be transformed into green land for urban and rural construction, and waste land for urban and rural construction will be expanded[31]. In addition, according to the maturity of urban agglomeration, optimize the ecological spatial structure of urban agglomeration. For mature urban agglomerations, the focus is to control the disorderly spread of production and living space in core cities, improve the population carrying capacity of living space in peripheral cities, and control the blind expansion of production space in peripheral cities. For the growing urban agglomeration, it is mainly to promote the upgrading and optimization of the production space of the regional core cities, increase the proportion of the production and living space of the peripheral cities, and promote the docking and integration of the production space of the core cities and the peripheral cities. For developing urban agglomerations, steadily increase the proportion of production and living space in core cities and peripheral cities, moderately increase the proportion of production space, and im-

prove the intensity of land development and utilization[15].

Control the ecological red line of urban agglomeration

Delimiting ecological protection red line is an important content of urban agglomeration space control. The ecological red line of urban agglomeration, also known as the ecological control bottom line, refers to the basic ecological control line drawn on the premise of respecting the integrity of the regional natural ecosystem and protecting the ecological service function[32]. Ecological red line includes ecological function red line, environmental quality red line and resource utilization red line, which involves many fields, such as ecological space protection, pollutant concentration control, total pollutant control, energy utilization, water resource utilization, land resource utilization and so on. First, the ecological function red line China's environmental protection law clearly defines the red line of ecological protection, including three categories including important ecological functional areas, ecologically sensitive or vulnerable areas and prohibited development areas. The second is the environmental quality red line, which mainly controls the key environmental indicators in the region, that is, environmental quality standard constraints and total pollutant control. National environmental quality standards include mandatory environmental quality standards, pollutant discharge standards and recommended standards. Mandatory environmental standards have formal legal effect through the invocation of laws. Urban agglomerations can be controlled by national environmental quality standards. The state has set "binding indicators" for total emission control of water, air and major pollutants. Third is the red line of resource utilization. In order to ensure the sustainable supply of basic strategic resources such as energy, water and land in urban agglomeration, it is necessary to determine the resource utilization red line. It includes energy utilization red line, water resource utilization red line, land resource utilization red line, etc.[33]

Table 1 Division of main ecological functional areas of Urban Agglomeration

	Meaning	Spatial range
Important ecological function reserve	This refers to the area that is related to the regional ecological security of urban agglomeration, the ecosystem function is degraded, and the development needs to be limited in order to maintain and improve the supply capacity of ecological products	Including water conservation, water conservation, biodiversity protection, wind and sand fixation and flood regulation and storage
Ecologically fragile or sensitive areas	This refers to the area where the structural and functional stability of the ecosystem is poor, the response to environmental changes is relatively sensitive, and it is vulnerable to external interference and degradation or frequent natural disasters	Including water loss sensitive area, ± desertification sensitive area and salinization sensitive area. Forest grass ecotone ecological fragile area, red soil hilly and mountainous ecological fragile area, mountainous farming and animal husbandry ecotone ecological fragile area, coastal water land interface zone ecological fragile area, etc.
Forbidden development zone	This refers to the areas for the protection of natural and cultural resources established according to law, as well as other key ecological functional areas that are prohibited from development and need special protection	It includes important water source protection areas, important wetlands, forest parks, nature reserves, scenic spots, world cultural and natural heritage and geoparks

Data source: compiled according to national ecological function zoning and national main functional area planning

4.3. Promote the construction of eco city in urban agglomeration

Eco-city agglomerations are based on ecological cities and are the result of the coupling between the development of urban agglomerations and the construction of ecological cities. Eco-city is a form of human habitation that integrates nature, city and people. American ecologist Richard Rijest put forward 10 plans for ecological city construction, involving popularizing and improving ecological

awareness, using ecological technology, strengthening ecological management, rebuilding urban ecology, improving ecological economic structure, strengthening ecological restoration, improving measures such as the public transportation system and the formulation of incentive policies[34]. Many of these experiences can be learned from our country. At present, we should focus on the following aspects.

Lead eco city planning

The construction of ecological city must emphasize the leading role of planning, carefully design the ecological city and prepare the construction plan of ecological city. Eco city planning specifically includes ecological space planning, ecological industry planning, ecological engineering planning and ecological management planning, involving the relationship between ecological environment, ecological economy and ecological society. In 1984, the United Nations put forward five principles of eco city planning in the report of "man and biosphere plan": ecological protection strategy including nature protection, animal and plant and resource protection and pollution prevention, ecological infrastructure (including natural landscape and hinterland), living standards of residents, cultural and historical protection, integrate nature into the city. These five principles summarize the main principles of eco city planning and provide a basic guiding ideology for China's eco city construction[35]. In the construction of eco city, China should also emphasize that eco city planning should be combined with urban master planning, environmental planning, transportation planning and industrial planning. Starting from the laws of natural ecology, we should make scientific arrangements for urban production, living and ecological space, realize the rational development, utilization and protection of natural resources, and promote the coordinated development of economy, society, resources and environmentevery city should set the goal of building an ecological city, strengthen the protection of ecological resources such as green space, forest land and wetland, and maintain the ecological bottom line through the preparation of ecological planning. Guide land development and urban layout with natural process, carry out ecological control and land use with smart growth thinking, reduce the impact of production and living space on natural ecological space and prevent the disorderly spread of cities. In the urban spatial layout, the concepts of "intensive", "compact" and "group" are introduced to emphasize the efficient utilization of urban space.

Give play to the supporting role of ecological economy

Ecological economy is the inherent requirement of ecological city. Ecological economy is essentially the ecologization of economic structure and economic activities, which limits the mode of human production and consumption to the range that the ecosystem can carry[36]. The basic principle of developing ecological economy is the coordination between economy and nature. The core of developing ecological economy is to develop the ecological industry that determines the overall development goal of ecological city. Eco industry is the pillar of eco city development. Eco city develops a low-carbon, circular and green industrial system, with high-tech industry as the leading factor, and develops education, medical treatment, tourism, logistics, culture, information and other industries. Eco city is a resource-saving city, which improves the utilization efficiency of natural resources by developing circular economy. The development of low-carbon economy is supported by the sustainable supply of energy. It is based on low energy consumption, low pollution and low emission, transforming and developing traditional industries with new technologies, and transforming and upgrading traditional industries with clean technology and environmental protection technology.

Jointly promoted by multiple subjects

The government is the core subject of eco city construction. The government integrates the eco city construction into the existing policy system through the guidance of industrial policy, science and technology policy, energy policy and financial policy. In terms of policy formulation, the government should put the eco economic construction in the first place

and strengthen the status and role of eco city in the construction of eco city cluster. Through urban ecological management, the government guides the scientific development of cities, green production of enterprises and low-carbon life and consumption of the public. The public and environmental ngos are the direct builders of eco cities. Without the participation of the whole people, the construction of eco city is just empty talk. The top priority is to strengthen public participation and strengthen the strength of third-party environmental protection organizations, such as promoting the process of eco city construction through green family, green community, green organ, green school and other creation activities.

In addition, enterprises are also the main participants in the construction of ecological cities. In short, the construction of ecological city needs the joint promotion of the government, enterprises and society. It can be completed through the ecological management of the government, the ecological production of enterprises and the ecological life of the public.

Conflict of interest

The author declares no conflict of interest.

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