



DEVELOPMENT OF ECOLOGICAL CONSCIOUSNESS THROUGH URBAN DESIGN AND DEVELOPMENT



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Abstract: Growing environmental concerns and the rise of sustainable development have made planners shift focus from prioritizing economic and social benefits to incorporating ecological consciousness into urban planning. Ecological challenges, such as habitat degradation from unchecked urban expansion and insufficient green spaces, underscore gaps in ecological awareness among urban planners. Issues, like urban heat islands and water mismanagement, further exemplify the need for enhanced ecological planning. To address these challenges, the paper proposes several governance strategies. It advocates for comprehensive planning for ecological civilization cities, including green infrastructures and natural landscape restoration to mitigate environmental impacts. Enhancing ecological responsibility, through education and community engagement, is vital for fostering a culture of sustainability. Developing an ecological circular economy addresses resource inefficiency and waste problems, while promoting low-carbon transportation options aims to reduce urban carbon footprints. Guided by the concept of ecological consciousness, this analysis offers actionable paths for improving urban ecological governance.


Keywords: Urban Governance. Ecological thinking. Pathways to Governance. Green Cities. Carbon footprint.

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Resumo: As crescentes preocupações ambientais e o aumento do desenvolvimento sustentável fizeram com que os planejadores mudassem o foco da priorização dos benefícios econômicos e sociais para a incorporação da consciência ecológica no planejamento urbano. Desafios ecológicos, como a degradação do habitat devido à expansão urbana descontrolada e à insuficiência de espaços verdes, destacam as lacunas na consciência ecológica entre os planejadores urbanos. Questões como as ilhas de calor urbanas e a má gestão da água exemplificam ainda mais a necessidade de um planejamento ecológico aprimorado. A fim de enfrentar esses desafios, o documento propõe várias estratégias de governança. Ele defende um planejamento abrangente para cidades civilizatórias ecológicas, incluindo infraestruturas verdes e restauração de paisagens naturais, para mitigar os impactos ambientais. O aumento da responsabilidade ecológica, por meio da educação e do envolvimento da comunidade, é vital para promover uma cultura de sustentabilidade. O desenvolvimento de uma economia circular ecológica aborda a ineficiência dos recursos e os problemas de desperdício, enquanto a promoção de opções de transporte com baixo teor de carbono visa a reduzir as pegadas de carbono urbano. Orientada pelo conceito de consciência ecológica, esta análise oferece caminhos práticos para melhorar a governança ecológica urbana.

Palavras-chave: Governança urbana. Pensamento ecológico. Caminhos para a governança. Cidades verdes. Pegada de carbono.

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DEVELOPMENT OF ECOLOGICAL CONSCIOUSNESS THROUGH URBAN DESIGN AND DEVELOPMENT¹

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Abstract: Growing environmental concerns and the rise of sustainable development have made planners shift focus from prioritizing economic and social benefits to incorporating ecological consciousness into urban planning. Ecological challenges, such as habitat degradation from unchecked urban expansion and insufficient green spaces, underscore gaps in ecological awareness among urban planners. Issues, like urban heat islands and water mismanagement, further exemplify the need for enhanced ecological planning. To address these challenges, the paper proposes several governance strategies. It advocates for comprehensive planning for ecological civilization cities, including green infrastructures and natural landscape restoration to mitigate environmental impacts. Enhancing ecological responsibility, through education and community engagement, is vital for fostering a culture of sustainability. Developing an ecological circular economy addresses resource inefficiency and waste problems, while promoting low-carbon transportation options aims to reduce urban carbon footprints. Guided by the concept of ecological consciousness, this analysis offers actionable paths for improving urban ecological governance.

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INTRODUCTION

Eco-city governance must navigate the challenges of managing urban size and growth, ensuring infrastructure keeps pace while leveraging smart technology, and balancing economic interests with environmental protection to foster sustainable development and a green economy (Davidson *et al.*, 2019, p. 3540).

Analyzing urban ecology is essential to enhance the efficacy of urban governance and address the primary challenge of achieving coordinated development among the urban economy, society, and ecology, as reflected in research on ecological consciousness in urban design, which evaluates the integration of ecological factors by urban planners, designers, and developers, with a focus on assessing planning levels and analyzing innovations like green infrastructure (Liu; Sui, Lin, 2018, p. 497).

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This research aims to promote sustainable urban development by establishing ecological networks, adopting green technologies, and exploring new governance methods to effectively manage public assets and address uncertainties caused by climate change (Cruz; Rode; Mcquarrie, 2019, p. 1). With the ecological cities' rise, their pivotal role in fostering low-carbon societies is becoming increasingly evident, especially in rapidly growing urban centers where innovation and economic development are driven by transformed governance structures (Marwell; Marantz; Baldassarri, 2020, p. 1559). Globally and locally, policies are promoting and advocating for ecological cities as the most environmentally friendly examples of sustainable urbanization. Livability assessment systems for ecological cities, covering environmental hygiene, transportation, safety, facilities and economic prosperity, help identify urban issues and guide targeted environmental improvements through quantitative assessments (Huang; Gao; Liu, 2019, p. 1651).

The ecological cities' planning and construction involve the application of numerous innovative technologies, such as intelligent transportation systems and the widespread use of renewable energies. These technologies not only enhance the efficiency of urban operations, but also significantly reduce environmental pollution. For example, intelligent transportation systems can effectively reduce traffic congestion and optimize traffic flow, thereby decreasing vehicular emissions. Similarly, the extensive adoption of renewable energies, like solar and wind power, is an important measure to improve urban energy efficiency and reduce carbon footprints.

In the meanwhile, the ecological cities' development is also a shift in social and cultural aspects. The urban residents' environmental awareness and behaviors play a crucial role in this process. Through education and community activities, residents' awareness and participation in sustainable lifestyles can be effectively enhanced, thus deeply rooting the concept of ecological cities. This widespread participation, from individuals to the community, is key to achieving true sustainable development.

1 HISTORICAL EVOLUTION OF URBAN ECOLOGICAL THOUGHT

“It is a city with harmony, social progress, efficient economic activities, and a virtuous ecological cycle” (Haqu; Yusanto; Wijaksono, 2020, p. 49). The ecological cities' development requires the development of circular economy. “Due to the fact that economic development is the foundation for building green cities, the rapid, healthy and sustainable development of the economy is an inexhaustible driving force for green cities” (Lund, 2018, p. 3).

The concept of ecologically friendly governance, in the historical evolution of urban ecological thought, may have different evolvement in different periods. In the early stage of urbanization, the main concern is the construction of urban infrastructure and population

management. Environmental issues were not the primary concern at the time, and urban planning focused more on practicality and economic development (Huang; Gao; Zhang, 2023, p. 601). With the acceleration of industrialization and the prominent problem of environmental pollution, city managers and residents began to pay attention to environmental health. The philosophy of this period emphasized reducing pollution and improving air and water quality. In the late 20th and early 21st centuries, sustainable development became mainstream and urban governance began to integrate economic, social and environmental aspects (Richardson; Durose; Perry, 2018, p. 145). The concept of eco-friendly governance emphasizes the cities' long-term sustainable development by balancing different interests.

Human understanding and practice of the ecological environment have gone through a process from the material environment to the spiritual environment, and then to the harmonious development of the relationship between humans and nature (Bibri, 2020, p. 1). In the early stages of human civilization, people's understanding of nature was still in the perceptual stage, lacking scientific methods and rational thinking. Urban residents always sincerely hope to give up the urban life's comfort and convenience. At the same time, they yearn for the peace and tranquility of the countryside. However, the idea of urban ecology has gradually matured, from the early simple ecological idea to the increasingly mature theory of urban ecosystem. It was not until the mid to late 20th century that the concept of ecological cities was finally established.

2 IMPACT FACTORS IN ECOLOGY FOR ECOLOGICAL CITY

Ecology is the study of the relationship between living organisms and their environment. It concerns the interactions between living organisms (including plants, animals and microorganisms) and the environments in which they live, and how these interactions affect the structure and function of ecosystems.

In urban planning, the goals of ecology include but are not limited to: (1) Improving the cities' ecological resilience to make cities more resilient to environmental changes and disasters; (2) Protecting the green space and water area in the city, mitigating the cities' negative impact on climate change through vegetation cover and carbon sink management.

In urban ecosystem, many factors affect its structure and functional behavior, but it is often the ecological factor, with the lowest critical value, that has the greatest impact on the function of urban ecosystem. Effectively increasing their value can greatly improve the function and performance of urban ecosystem.

2.1 DIVERSITY AND STABILITY

“Community diversity is generally positively correlated with ecosystem stability” (Archer; Colenbrander; Dodman, 2017; Zhang, 2019). Diversity can improve the adaptability of communities to environmental changes and increase their ability to resist external disturbances, thereby maintaining ecosystem stability. Diversity has a positive impact on the functioning of ecosystems. Different species play different roles in the ecosystem, participating in ecological processes, such as energy flow and material circulation, to promote the normal operation of the ecosystem (Marks; Pulliat, 2022, p. 141). Diversity is also associated with the resistance of communities to disease. In a highly diverse community, pathogens tend to have difficulty spreading through the community because different species have different resistance to different pathogens (Wu *et al.*, 2021, p. 61).

The principle of diversity leading to stability is also reflected in urban biogeographical systems. For example, the diversity of human resources and their different materials ensure the development of different human resource intensive enterprises in a city. The different characteristics of different urban areas ensure the development of different activities within a city (Grochulska-Salak, 2021, p. 3). The complex effects of multiple urban functions and transportation modes make a city more attractive and successful than a single functional one. The diversity and complexity of urban environment and economy are the determining factors for a city’s stability and prosperity.

2.2 COMMUNITY SUCCESSION

Ecology believes that community succession is an important component of an ecosystem and a continuous process. In this process, an area with the same terrain and geology or climate changes from one community to another, gradually becoming a stable community due to changes in environmental physical conditions. In practice, the development and utilization of biological resources, the creation of new forests, the management of grasslands, and the reform of agricultural systems, involving natural or artificially cultivated communities, are closely related to community succession.

Only by mastering the laws of community succession, natural resources can be developed without violating objective laws, thereby consciously avoiding “ecological decline”, sustainably enhancing the nature’s potential and benefiting humanity. Although cities are constantly changing, providing opportunities and venues for various experiments and research, there must be a strong thread running through these changes (Yao *et al.*, 2023, p. 2493). A city’s culture, history, heritage, buildings, neighborhoods and communities must be regarded as a life system that must be preserved, protected, developed and updated, based on its “life history” and condition.

2.3 SYMBIOSIS AND CO-EVOLUTION

Biologist Lincoln Brooks developed the theory of symbiosis, which emphasizes co-existence as a fundamental driving force in the life's evolution. She believes that the different organs in the cell were originally formed through symbiosis, and that the driving force of evolution is not just competition, but cooperation. Dawkins emphasizes the interaction and coevolution of genes. He believes that gene coevolution is an important aspect of gene interaction in the process of evolution.

Symbiosis and coevolution are common phenomena in ecosystems. The ideas of symbiosis and coevolution guide ecological research, from solution design to interpretation of results. Symbiotic relationships are the foundation for the orderly accumulation of biological populations and the formation of self-organizing functional structures in ecosystems. Symbiotic relationships are the foundation for establishing self-organizing functional structures. As far as the urban ecosystem is concerned, the symbiotic relationship has greatly saved the resources, energy and transportation of all parts of the system, thus making the system obtain multiple benefits, replacing the single function land use, single function industry, distributed management system and low internal diversity. Similarly, single functional land use, single functional industries, decentralized management systems, low internal diversity and low symbiotic relationships do not bring significant ecological and economic benefits.

Taking parks and squares, as examples for analysis, they are each city's "fortresses" and the ones of residential area. They should not become a means of repairing fragmented urban landscapes, nor should they become isolators, buffers, and separators between streets and buildings and the surrounding architectural environment (Ude, 2022, p. 3). Parks and squares are the spiritual habitats of a region, and therefore should be given special status, with special emphasis on their ecological functions. As a high-density communities' fundamental element, parks and squares should be lively, dynamic and enjoyable. They are gathering places among neighbors, centers for activities and sports, ideal places for daycare and suitable for couples to gather. As public spaces serve social activities, their optimal location is in the center or core of residential areas. They should help support retail activities and improve the quality of life in residential areas.

3 PROBLEMS AND GOVERNANCE PATH IN ECOLOGICAL CITY CONSTRUCTION

In a broad sense, urban governance is concerned with issues, such as urban planning, design and sustainable development, mainly involving different elements of urban development. In a narrow sense, urban governance mainly involves the organization of management, conflicts of interest and integrating various interests, with a focus on the provision of urban public services. All the section works with the broader notion.

3.1 ENHANCING ECOLOGICAL RESPONSIBILITY AWARENESS

The masses' ecological awareness is relatively weak. From the masses to cadres, there is a lack of understanding of the crisis that environmental degradation brings to the survival and development of the region. There is mostly no understanding of ecological environment protection, and there is a superficial understanding that everything about protecting and governing the environment is a state's matter, and it cannot participate in urban construction voluntarily. Various systems are prone to errors in the implementation process. Some cities do not have specialized regulatory departments, or some staff have unclear responsibilities and lax law enforcement.

Promoting ecological responsibility awareness necessitates a multifaceted approach encompassing ecological education, community engagement and policy advocacy. By integrating ecological principles into educational curricula, fostering community-based environmental initiatives and incentivizing sustainable practices, urban stakeholders can cultivate a culture of environmental stewardship and collective action.

Ecological education includes ecological civilization awareness education, ecological civilization knowledge education, ecological civilization moral education and legal one. The essence of education is people-oriented, asking for needs from the people, and making people feel that they can easily strive to improve their lives. It is necessary to turn environmental improvement into social consensus and to cultivate all people's conscious attitude and ability to practice environmental civilization. Firstly, it is necessary to popularize environmental and cultural knowledge, and combine it with characteristic cultures, such as book clubs, to strengthen the promotion and education of environmental civilization. The second is to promote public participation, cultivate environmental protection values, and promote the concept of ecological consumption and ecological lifestyle by establishing ecological families, ecological schools, ecological communities and ecological demonstration cities. The third is to make full use of modern propaganda networks to create a strong atmosphere of building an ecological civilized city and involving the whole people in building a green city throughout the city. It is important to fully recognize that humans are not the main organs of the ecosystem, but rather a normal component of it. The public should be encouraged to change their way of thinking to respect nature and take the initiative to join the team to build an ecologically civilized city.

3.2 DEVELOPING ECOLOGICAL CIRCULAR ECONOMY

The environmental challenges facing urban areas, particularly those related to heavy industrial activities and governance issues, stem from outdated economic development policies that prioritize industrial growth over ecological sustainability. To address these challenges, there is a need to revise such policies to favor environmentally sustainable practices.

Advancing ecological circular economy necessitates a strategic approach encompassing resource optimization, industrial diversification and sustainable agricultural practices. By promoting resource recycling, fostering green industrial parks and incentivizing low-carbon agriculture, cities can transition towards a more resilient and resource-efficient economic model. It is necessary to vigorously develop ecological recycling agriculture and improve the efficiency of green industry. The development of circular economy is the linkage of projects, and the serialization should be completed around the five industrial chains of circular economy and the circular chain of agricultural economy. The design reserve before the serialization should be started, and the project packaging design should be done to establish a circular economy project library to provide support for the circular economy projects.

In the development of industrial resource industries, one must develop the field of industrial raw materials. The key coal resources should be fully developed, the level of processing should be improved by mining, retaining and exploring new resources to slow down the depletion of mineral resources, and the adjustment and transformation of resources and processing industries should be done. The second is to accelerate the industrialization of resources. It is necessary to continuously expand the industrial chain, transform the coal industry from a single industry to a mining one and achieve diversified processing industries. The third is to build green industrial parks, relocate urban industrial ones and optimize planning. Based on comparative advantages, cities establish industrial parks for key industries, expand industrial chains, and develop primary and secondary industries extensively. Taking into account road costs, land prices, climate conditions and other human, logistic and capital flows, high pollution and high energy consumption enterprises are reduced. By fully considering environmental and nature protection factors, local industries in suitable locations are focused on development.

Developing low-carbon agriculture is considered a part of the development of the agricultural sector. Firstly, it is necessary to better utilize agricultural resources and improve the comprehensive benefits of agriculture. On the basis of stable growth, the proportion of the primary industry should be reduced. Attention should be paid to the connection between the primary and secondary industries, and the expansion of the industrial chain. Secondly, it is necessary to develop characteristic industries, actively promote leading enterprises and reflect product characteristics. Technology should be emphasized in craftsmanship, and advantages should be prioritized in management to increase high value-added products. It is necessary to follow the path of enterprises and transform regional resource advantages into product advantages, market advantages and economic ones.

It is necessary to actively develop the low-carbon service industry and focus on developing green services and low-carbon logistics. Green services require reducing carbon emissions and achieving energy and resource conservation through the design, budgeting,

marketing and other aspects of the service delivery process. Low carbon logistics mainly refers to optimizing processes in the logistics industry, integrating different resources, implementing standardization and other measures to promote energy conservation and emission reduction.

3.3 IMPROVING URBAN LOW CARBON TRANSPORTATION FACILITIES

Integrating ecological considerations into urban planning can significantly mitigate the impacts of climate change and improve urban resilience. This includes creating green zones, enhancing public transportation systems to reduce private vehicle use and implementing sustainable water management practices. Legal frameworks should also be revised to include rigorous environmental impact assessments for industrial projects and enforce sustainable practices with stringent penalties for non-compliance. Promoting a cultural shift towards environmental responsibility through media, education and public figures can cultivate a greater collective action ethos for ecological conservation. These measures, if implemented effectively, can pave the way for more sustainable and ecologically balanced urban development.

Successful low-carbon transportation initiatives, such as the implementation of bike-sharing programs and pedestrian-friendly infrastructure, have transformed urban mobility and reduced carbon emissions. Case studies from cities, like Copenhagen and Amsterdam, demonstrate how strategic investments in cycling infrastructure and pedestrian zones have improved air quality, reduced traffic congestion and enhanced residents' quality of life.

To implement eco-city governance effectively, it is crucial to understand and overcome several barriers, starting with regulatory and legal challenges. Circular economy practices, such as innovative waste management and resource recovery, often face rigid laws that can hinder progress. Adapting these policies to support more flexible approaches, coupled with incentives for recycling and green technology, can help mitigate these issues.

Technical and financial constraints also play a significant role. The deployment of advanced public transportation systems and the integration of different transport modes require not only sophisticated technology, but also substantial investment. Addressing these technical challenges necessitates investments in research and development, while financial hurdles can be overcome by exploring funding options, like public-private partnerships, international grants, or green bonds. These financial models should highlight the long-term environmental and economic benefits to attract investors.

Public resistance and low awareness about eco-friendly practices present another significant barrier. To build public support, it is essential to engage with the community continuously and run educational campaigns that elucidate the benefits of sustainable practices. Highlighting how these practices can improve the quality of life, promote health and ensure long-term environmental sustainability can change public perceptions and behaviors.

Moreover, integrating all aspects of sustainability in urban planning is crucial. This involves designing comprehensive public transportation networks, planning for sustainable water management and ensuring ample green spaces. Such integrated planning ensures that the infrastructure and services meet all residents' needs, promoting a higher quality of urban life and greater environmental resilience.

By tackling these challenges through strategic measures and collaborative efforts across government, industry and community sectors, cities can enhance their governance models. This enhancement will not only support sustainable development, but also prepare urban areas to be more adaptive to climate change and improve overall livability. Collaboration and commitment to these goals are essential for the long-term success and sustainability of eco-city initiatives.

4 PLANNING FOR THE CONSTRUCTION OF ECOLOGICAL CIVILIZATION CITIES

In order to build a green and civilized city correctly, green ecology must be regarded as a necessary condition for sustainable development and meeting citizens' aspirations for a better life. The comprehensive planning, based on resource and ecological capabilities, green design, urban planning, farmland and urbanization models, should be thoroughly promoted.

4.1 FORMULATING URBAN DEVELOPMENT POLICIES

To advance the green cities' development and sustainable urban planning, a multifaceted approach is essential. Formulating Urban Development Policies requires continuous strengthening of incentives through policies that cater to the consumers' needs, guiding them towards low-pollution and high-quality products to reduce energy consumption and enhance the ecological environment. Large industrial enterprises should integrate public feedback on the application of environmentally friendly production technologies, producing environmentally friendly products that help consumers understand the production processes and their reduced impact on the environment.

It is possible to build a good green city by continuously strengthening incentives through policies. The government should cater to the consumers' needs and provide reasonable guidance, so that they can seek to purchase low-pollution, high-quality products and reduce energy consumption while improving the quality of the ecological environment. For large industrial enterprises, they should integrate the opinions of public institutions on the application of environmentally friendly production technologies and produce a large number of environmentally friendly products, enabling consumers to better understand the production process of products, mainly reducing environmental and ecological pollution.

To make green cities more sustainable, relevant departments should continuously improve their existing management systems and establish environmentally friendly green areas in the city's some parts, taking into account the city's development needs. According to the city's development, some financial support is provided to enhance the urban residents' environmental awareness. In addition, urban and rural development departments should take into account the urban residents' housing ideas. A low-carbon environmental management system should be established to ensure effective solutions to urban development issues. In order to better continue urban culture, it is necessary to attach importance to the city's cultural landscape, and fully utilize the role of urban cultural landscape and the cultural potential of the region to effectively improve the urban residents' living standards and create a more beautiful living environment.

4.2 CONTINUOUSLY RUNNING THROUGH THE CONCEPT OF ECOLOGICAL CIVILIZATION AND SUSTAINABLE DEVELOPMENT

To build an ecological civilized city, it is necessary to rely on the role of urban green environment, with respect and protection of nature as the starting point, and strive to achieve harmonious coexistence among people, people and nature, and people and society. Based on ecological construction, it is necessary to take the lead in building a national ecological protection and construction demonstration zone, raise awareness of protecting natural resources to strengthen institutional guarantees and environmental protection, and all aim to improve the urban residents' quality of life. Given the richness and particularity of natural and cultural resources, in building a civilized and ecological city, it is necessary to widely solicit public opinions, and reasonably plan agricultural and construction land.

In order to better leverage the role of green concepts in the construction of ecological cities, urban management should be combined with the ecological towns' rules and regulations, and green concepts should be carefully analyzed. Based on the urban management situation, the original green concept should be continuously improved, so as to achieve ecological towns' more effective development. Different from the traditional industrial city, the ecological town does not pollute the environment during its operation, which can realize the man and nature's harmonious development, making the relationship between man and nature more harmonious, and the relationship between man and society more closely.

In addressing the complexities of waste disposal cost management and the economics of coal, a comprehensive approach that considers policy, technical and economic dimensions is essential. Cost management of waste disposal can be significantly optimized through a cost-benefit analysis, which evaluates the financial and environmental impacts of various waste treatment methods. By assessing these aspects, cities can select treatment options that not

only minimize costs, but also maximize environmental benefits. This approach encourages the adoption of economically viable and ecologically sustainable practices in waste management.

Innovative technology plays a critical role in enhancing the efficiency of waste treatment processes. Technologies, such as efficient waste separation, incineration and biodegradation, should be promoted to improve overall waste management systems. These technologies not only help in reducing the volume of waste, but also in recovering valuable resources from waste, thereby contributing to the sustainability goals of urban areas. Implementing these innovative solutions can lead to more effective and less environmentally damaging waste treatment methods, aligning with broader ecological objectives.

However, the implementation of these technologies is not without challenges. The current technological landscape for green energy and waste management has its limitations, such as high costs, inadequate efficiency, or technological immaturity. Recognizing these limitations is crucial, as is the need for increased investment in research and development. Enhancing technological capabilities and innovating new solutions are vital steps toward overcoming these hurdles and achieving better waste management and energy production processes.

Finally, the energy transition, which involves shifting from traditional energy sources to more sustainable ones, requires a balanced approach. This transition is a gradual process that needs to ensure the development of new energy sources while maintaining the reliability of the energy supply. The balance is critical to prevent disruptions and to support continuous energy availability for urban populations. It involves careful planning, significant investment in clean energy technologies and strategies to phase out older, less efficient and more polluting energy sources. This comprehensive approach ensures that the transition to greener energy sources is both sustainable and beneficial for the community and the environment.

Compared with modern cities, ecological towns have good integration functions, which can effectively connect the social environment, national economy and ecological environment, ensuring the quality of the ecological environment and promoting the cities' effective development. The ecological cities' management personnel need to follow the concept of sustainable development, create a good environmental culture and integrate the development requirements of different regions to continuously improve the initial goal process of construction. The application of the concept of sustainable development can increase the speed of urban development, ensure effective improvement of the urban ecological environment, and promote harmony between people and nature.

4.3 OPTIMIZING RESOURCE ALLOCATION

The government should maximize the potential of tax incentives designed for comprehensive resource utilization and waste recycling, by implementing preferential policies

that foster enterprise development. To further support sustainability goals, increased financial investment is essential in regional projects, such as centralized disposal of urban hazardous waste, classification and recycling of resources, and the construction of public facilities for the recycling of renewable resources. Additionally, enterprises should be encouraged to adopt linkage technology and industrialization projects that align with clean production and the principles of a circular economy, including the adoption of advanced sewage charging technology.

To revitalize the coal industry, a strategic push toward the integration and restructuring of this sector is critical. This involves phasing out outdated production capacities and inefficient mining methods. The implementation of green mining technologies — such as water-saving coal mining, backfill mining, coal to gas conversion and underground gasification — should be actively promoted. Moreover, the city should consider consolidating polluting enterprises into designated industrial parks to facilitate unified control over pollution sources.

Furthermore, comprehensive management should be strengthened across various sectors, including energy and water supply, waste management, sewage treatment and public transportation, to optimize resource allocation effectively. This comprehensive approach ensures that infrastructure and services are tailored to meet the community's needs while promoting sustainability.

There is also a pressing need to introduce the latest technologies to enhance the management of the ecological environment. Technologies, such as advanced agricultural water conservancy, ecological collaborative design, biological control and pollutant waste treatment, should be adopted to improve ecological health and sustainability. In parallel, efforts should be made to cultivate and utilize unique cultural resources to foster an ecological and cultural city's development.

CONCLUSIONS

Future research on ecological consciousness in urban design should prioritize comparative and longitudinal studies to deepen our understanding of sustainable urban development. Comparative analyses across various cities can highlight effective practices and common obstacles, considering the influence of cultural, economic and political contexts. Additionally, longitudinal studies are essential to track the evolution of ecological practices over time, offering insights into the adoption, modification and long-term impacts of sustainable strategies. This approach allows for a dynamic understanding of how ecological measures evolve and their sustained impact on urban environments.

There is also a critical need to quantify the impacts of ecological urban design through robust data collection and analysis. Research should focus on measuring key environmental sustainability indicators, such as carbon emissions, air and water quality improvements, and

energy efficiency enhancements. Quantitative assessments can substantiate the benefits of ecological designs and motivate more cities to implement sustainable practices. Furthermore, exploring technological innovations and their integration into urban planning could provide breakthroughs in enhancing urban ecology. Studies could investigate the potential of emerging technologies, like smart grids, green building materials and advanced water systems, assessing their effectiveness and integration challenges.

Engagement with a wide array of stakeholders, including urban planners, government officials, community members and industry experts, is crucial for the applicability and relevance of research findings. Collaborative research efforts can ensure that studies address real-world challenges and generate actionable insights. Additionally, examining how policy and institutional frameworks influence the adoption of ecological practices can provide valuable information for crafting supportive policies. Analyzing different legislative and regulatory environments will help identify needed policy innovations to foster sustainable urban development, thus paving the way for cities to become more sustainable and harmoniously integrated with their natural surroundings.

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