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Systematic Ecological Resilience Strategies & Practices in China's National Land Space

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Abstract

In the context of global climate change and rapid urbanization, faced with a series of ecological degradation problems, the Chinese government has continuously deepened the strategic deployment of ecological restoration in the past 20 years, explored and promoted the transformation of ecological restoration from partial and single-factor restoration to comprehensive, multi-scale and multi-factor integrated protection and restoration and comprehensive management. China focus on measures in three aspects: first, control territorial ecological space, delineate and strictly observe the national ecological protection red line, and ensure and safeguard the national ecological security bottom line; Second, research and practice on the localization of Nature-based Solutions in China to strengthen the natural resilience of the ecosystem; Finally, a major ecological protection and restoration project integrating mountains, water, forests, fields, lakes, grass and sand has been implemented, and the function of ecosystem services has been gradually enhanced.

Keywords: Ecological Protection Red Line; NbS Localization; Systematic Resilience of Multi-Scale & Multi-Factor.

1. Introduction

1.1. Challenges Faced by the Governance of China's Territorial Spatial Ecosystem

In the context of global climate change and rapid urbanization, the main problems of China's ecosystem: sharp reduction of coastal wetland area and fragmentation of landscape patches, grassland degradation, natural forest reduction, lake shrinkage and river drying up, land desertification intensification, ecosystem function reduction, etc.:

- 1.1.1. Ecological space is under continuous threat. Development and construction activities such as urbanization, industrialization, infrastructure construction, and agricultural reclamation occupy ecological space; The fragmentation of ecological space is intensifying, and the construction of transportation infrastructure, river hydropower and water resources development, and industrial and mining development directly sever the integrity and connectivity of biological habitats.
- 1.1.2. The quality and service function of the ecosystem have weakened. Low quality ecosystems are widely distributed, and the area proportion of forest, shrub and Grassland ecosystems with low quality is 43.7%, 60.3% and 68.2% respectively. The problems of soil erosion and land desertification are prominent throughout the country, the supply of ecological products in urban areas is insufficient, the green land area is small and scattered, and the water system is seriously artificial. The role of the ecosystem in alleviating the Urban heat island effect and purifying the air is very limited.
- 1.1.3. According to international (IUCN) standards, the threat level of Chinese species is much stricter than expected. According to the investigation and evaluation of 191 plant species by the National Forestry Administration, 3 species have completely disappeared, 12 species have only 1-10 individuals, 9 species have only 11-100 wild individuals, and over 44.5% of species have less than 50000 individuals in their original habitats. The threats to biodiversity in China are multifaceted. The main pressure is that, with the rapid growth of population and the acceleration of industrialization and urbanization, the degradation or loss of wildlife habitat, excessive use of natural resources, serious environmental pollution, large-scale cultivation of single species, invasion of Introduced species and climate change are caused.
- 1.1.4. Urban expansion is out of control, and the living environment is deteriorating. The phenomenon of selling large cakes during urban expansion is common. Most urban built-up areas adopt a single center expansion model of spreading big cakes. Since 2000, the main urban areas of 17 key cities have expanded by 2-4 times. The ecological regulation function of cities continues to decrease, and the "heat island effect" of all major cities in the country continues to strengthen. 62% of cities in China suffer from urban waterlogging, with 74.6% having a maximum depth of over 50 centimeters, which has a serious impact on residents' lives. The structure of Urban green space is simple, and the proportion of exotic plants is high. For example, the proportion of exotic plant species in Beijing urban area is as high as 52.7%, and the species of wild animals and plants are few and the population is low.
- 1.1.5. The ecological damage in the watershed is severe, and the ecological risks are enormous. Due to the large-scale development of water and hydropower resources, the river ecosystem in China is facing huge impacts, including river interruption, wetland loss, and significant increase in wastewater discharge. The

water environment is severely polluted, biodiversity is reduced, and ecological regulation functions are low. The ecological environment deterioration trend in the Yangtze River Basin, Yellow River Basin, and Haihe River Basin is particularly significant.

In order to achieve the goals of optimizing the spatial pattern of China's territory, improving the health and stability of the ecosystem, and enhancing its ecological functions, and to improve and restore the ecosystem, China has put forward the following major strategic requirements for the systematic implementation of territorial and spatial ecological restoration: In accordance with the principle that mountains, rivers, forests, fields, lakes and grasses form a community of life, we will take comprehensive measures, both engineering and non-engineering, in areas that have suffered from the long-term effects of high-intensity development and construction, irrational utilization, and natural disasters, resulting in serious damage and degradation of the ecosystem, ecological dysfunction, and reduced ability to supply ecological products. Systematic ecological restoration, ecological remediation, ecological reconstruction and ecological rehabilitation will be carried out to achieve sustainable development of the territorial space.

In the context of global climate change and rapid urbanization, faced with a series of ecological degradation problems, the Chinese government has continuously deepened the strategic deployment of ecological restoration in the past 20 years, explored and promoted the transformation of ecological restoration from partial and single-factor restoration to comprehensive, multi-scale and multi-factor integrated protection and restoration and comprehensive management. China focus on measures in three aspects: first, we will control territorial and ecological space, delineate and strictly observe the national ecological protection red line, and ensure and safeguard the national ecological security bottom line; Second, research and practice on the localization of nature-based solutions in China to strengthen the natural renewal of the ecosystem; Last but not least, a major ecological protection and restoration project integrating mountains, water, forests, fields, lakes, grass and sand has been implemented, and the function of ecosystem services has been gradually enhanced.

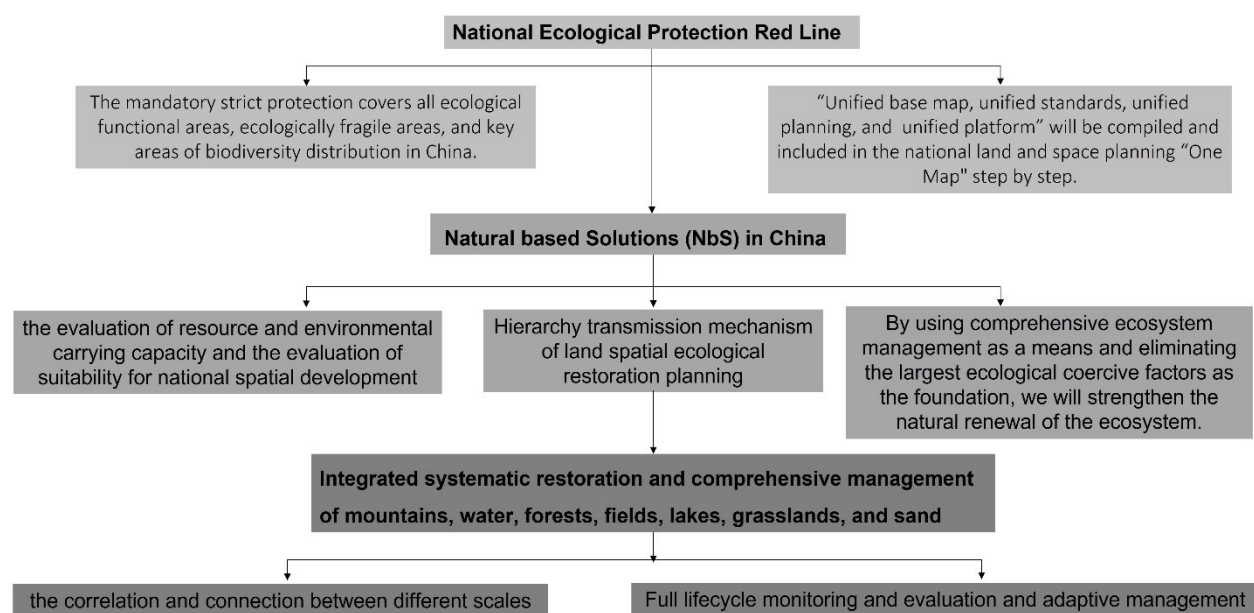


Figure 1. Structure of the Study

2. Draw and strictly adhere to the national ecological protection red line, ensure and maintain the national ecological security bottom line

First, we will draw and strictly observe the national red line for ecological protection. The red line for ecological protection refers to the areas within the scope of ecological space that have special important ecological functions and must be protected mandatory and strictly. It is the bottom line and lifeline for ensuring and maintaining national ecological security.

As an important content of supervision over the implementation of national spatial planning and ecological environment supervision, as well as an important basis for the control of national spatial use. The national ecological protection red line shall not be less than 3.15 million square kilometers, of which the land ecological protection red line shall not be less than 3 million square kilometers and the marine ecological protection red line shall not be less

than 150000 square kilometers. The red line area of land ecological protection accounts for over 30% of the land area, with 90% of important ecosystem types and 98% of wild animals and plants being protected.

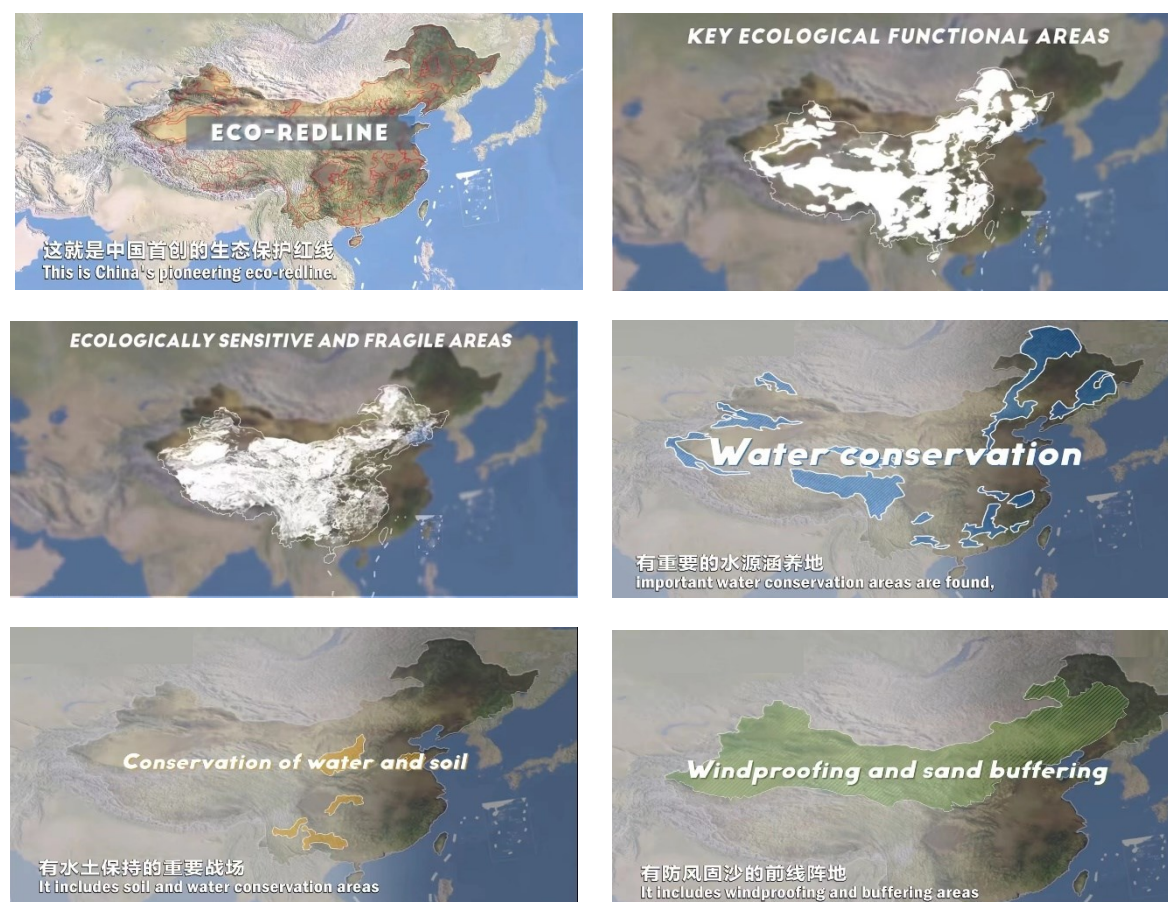


Figure 2. Ecological Protection Red Line

2.1. Method for delineating ecological protection red lines

Priority will be given to the ecological protection red line in areas with extremely important ecological functions, such as important water conservation, biodiversity maintenance, water and soil conservation, wind prevention and sand fixation, coastal protection, and areas with extremely sensitive and fragile ecology, such as water and soil loss, Desertification, rocky desertification, and Coastal erosion. Other areas that have been assessed as potentially important ecological values, although currently uncertain, are also included in the ecological protection red line. Adjust and optimize natural reserves, and evaluate that the adjusted natural reserves should be included in the ecological protection red line; If there is an adjustment to the nature reserve, the ecological protection red line shall be adjusted accordingly.

2.1.1. Ecological function assessment method:

Determine the location and scope of the ecological protection red line by evaluating the ecosystem functions within the area, including indicators such as soil and water conservation, biodiversity, and ecological stability.

2.1.2. Ecological sensitivity assessment method:

By assessing factors such as geological terrain, hydrology and water resources, soil quality, etc. within the area, the ecologically sensitive area is determined and designated as an ecological protection red line.

2.1.3. Ecosystem Service Value Assessment Method:

Determine the location and scope of the ecological protection red line by evaluating various services provided by the ecosystem within the area, such as water conservation, soil conservation, climate regulation, etc.

2.1.4. Expert consultation method:

Invite experts from relevant fields for evaluation and consultation, and determine the location and scope of ecological protection red lines based on their opinions and suggestions.

These methods can be comprehensively applied to develop suitable ecological protection red line delineation plans based on specific geographical, ecological, and socio-economic conditions.

2.2. Ecological Red Line Supervision Measures

2.2.1. Limited human activities

Within the ecological protection red line, in principle, human activities are prohibited in the core protected areas of nature reserves, and development and productive construction activities are strictly prohibited in other areas. Under the premise of compliance with existing laws and regulations, except for major national strategic projects, only limited human activities that do not cause damage to ecological functions are allowed.

Sporadic indigenous people, without expanding the scale of existing construction land and arable land, repair production and living facilities, and retain a small amount of necessary planting, grazing, fishing, and breeding for daily life; Strategic energy resource exploration, public welfare natural resource exploration, and geological exploration required for national major energy resource security; Natural resource and ecological environment monitoring and law enforcement, including hydrological and water resource monitoring and investigation of illegal water related incidents, disaster prevention and emergency rescue activities; Non destructive scientific research observation and specimen collection approved by law; Archaeological investigation, excavation, and cultural relic protection activities approved by law; Moderate tourism and necessary public facilities construction that do not damage ecological functions; The construction and operation maintenance of linear infrastructure, flood control, and water supply facilities that must and cannot be avoided and comply with the national spatial planning at or above the county level; Important ecological restoration projects.

2.2.2. Unified data foundation and establishment of a Five-sphere monitoring system

Adhere to data sharing standards and achieve data sharing and exchange. Data sharing should follow the principles of data security and privacy protection to ensure the security and confidentiality of data. "Unified base map, unified standards, unified planning, and unified platform" will be compiled and included in the national land and space planning "One Map" step by step.

Organize and carry out ecological quality monitoring of the ecological protection red line, with a focus on the impact of human activities on the ecological environment of the ecological protection red line. Through the "Five Basics" collaborative ecological remote sensing monitoring system, which integrates five means: space-based satellites, space-based remote sensing, aviation drones, mobile patrol monitoring vehicles, and ground observation equipment, it can achieve near real-time 360 ° high-precision monitoring.



Figure 3. Five-Sphere Monitoring System

3. Localization of Natural based Solutions (NbS) in China to enhance the natural resilience of ecosystems

Amidst the triple environmental threat of biodiversity loss, climate disruption and escalating pollution, United Nations launched the UN Decade on Ecosystem Restoration. Now is the beginning of this work, and restoring the natural space lost due to development requires global joint efforts.

China's natural based solution is the China Shan-Shui Initiative. The Shan-Shui initiative – which translates to “mountains and rivers” – is an ambitious country-wide effort to restore 10 million ha of natural spaces, including forests, grasslands and waterways. Between 2021 and 2030, China is aiming to complete 50 projects stretching across 700 counties, focusing on the large-scale protection and restoration of entire ecosystems. By 2030, that is expected to create more than 3.2 million jobs in a range of industries, from tourism to wine-making. An estimated 70 million households, or 200 million people, are expected to benefit from the work. One of the main experiences of landscape engineering is to implement ecological protection and restoration strategies under the guidance of the

national spatial planning system, with a focus on overall protection, systematic restoration, and comprehensive management of various natural ecological elements in a certain area.

3.1. Hierarchy transmission mechanism of land spatial ecological restoration planning

The work related to natural resource management in China is highly consistent with NbS, such as conducting land use control and ecological protection and restoration, responding to a series of economic, social, and ecological challenges in the new era; To achieve sustainable utilization and management of natural resource assets, enhance human well-being, and so on (Amen, 2021, Aziz Amen, 2022, Amen et al., 2023, Amen & Nia, 2020).

China's national spatial planning adopts the evaluation of resource and environmental carrying capacity and the evaluation of suitability for national spatial development. In the transmission of spatial planning at all levels, timely weighing and feedback are conducted to take necessary measures to balance multiple planning objectives in the natural environment and economic society, reduce adverse impacts, and achieve coordinated and sustainable development of production, life, and ecology. This is highly consistent with the emphasis on synergy and trade-offs reflected in the global standards of NbS.

The transmission mechanism of land spatial ecological restoration planning refers to the transmission of the goals, principles, tasks, and policy measures of land spatial ecological restoration planning to governments and relevant departments at all levels to achieve the goal of ecological restoration.

The specific content of this mechanism includes:

3.1.1. Planning transmission:

The ecological restoration plan for land space needs to be formulated and transmitted by governments at the national, provincial, and municipal levels according to a hierarchical system.

3.1.2. Target transmission:

Transmit the ecological restoration goals determined in the national spatial ecological restoration plan to all levels of government and relevant departments, and clarify the responsibilities and tasks of all levels of government in ecological restoration.

3.1.3. Principle transmission:

Transmit the ecological restoration principles determined in the national spatial ecological restoration plan to all levels of governments and relevant departments, guiding their decision-making and actions in land use, environmental protection, and other aspects.

3.1.4. Policy measures transmission:

Transmit the policy measures determined in the national land spatial ecological restoration plan to all levels of government and relevant departments, guiding the specific implementation of land management, ecological compensation, ecological protection, and other aspects by all levels of government.

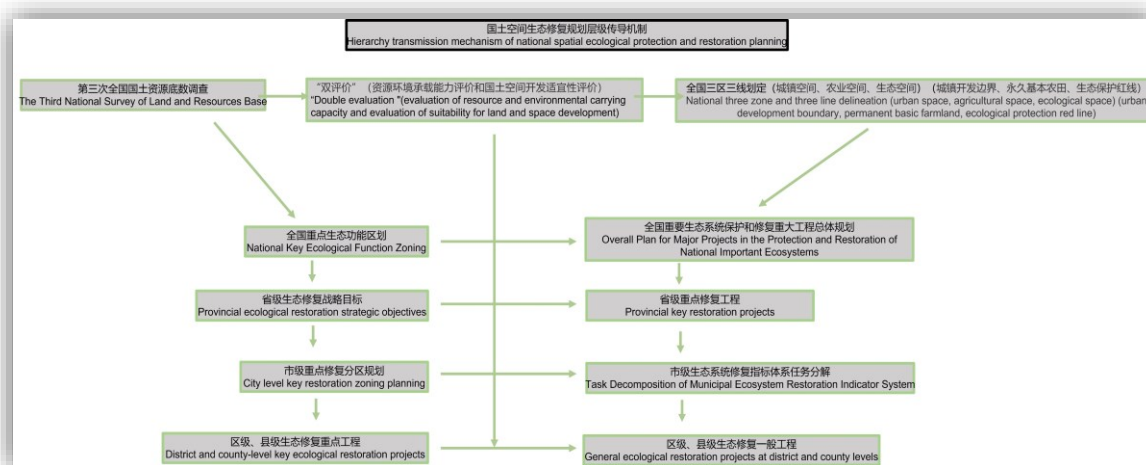


Figure 4. Hierarchy transmission mechanism of land spatial ecological restoration planning

3.2. Eliminating ecological stress factors

By using comprehensive ecosystem management as a means and eliminating the largest ecological coercive factors as the foundation, we will strengthen the natural renewal of the ecosystem. Guanting Reservoir is one of China's local demonstration projects based on natural solutions. Through a series of ecological restoration and comprehensive management measures, the environment of the reservoir area has been greatly improved.



Figure 4. Comparison of Guanting Reservoir before and after restoration

4. Integrated systematic restoration and comprehensive management of mountains, water, forests, fields, lakes, grasslands, and sand, gradually enhancing the ecosystem service function

4.1. Emphasize the correlation between different scales

At different scales such as regions (or watersheds), ecosystems, and sites, engineering planning, design, and implementation should be carried out to solve different problems at different scales. At the same time, attention should be paid to the correlation and connection between different scales.

Adapt to the relevance of ecosystems. One is spatial correlation. It is necessary to comprehensively consider the integrity of natural geographical units and the correlation of ecosystems, take into account the ecological space where important ecosystems are located, as well as the agricultural and urban spaces closely related to them, and carry out ecological protection and restoration by zoning and classification under the development and utilization pattern and use control of national land space. The second is the correlation of elements. Based on the natural ecological conditions of the region, in response to prominent ecological issues, protect and restore multiple types of natural ecological elements such as mountains, rivers, forests, fields, lakes, and grasses that are related to a certain area. The third is the correlation between different scales. At different scales such as regions (or watersheds), ecosystems, and sites, engineering planning, design, and implementation should be carried out to solve different problems at different scales. At the same time, attention should be paid to the correlation and connection between different scales. For example, the ecological protection and high-quality development planning of the Yellow River Basin reflects the design based on scale, which means coordinating various elements of governance on a larger spatial scale. At the basin scale, the overall planning, design, and restoration are carried out from the source to the agricultural area to the reservoir area.

Upstream water source conservation, building the "China Water Tower", comprehensively protecting the ecological elements of mountains, rivers, forests, fields, lakes, grass, and sand in the Three Rivers Source Area, restoring biodiversity, and achieving a virtuous cycle of ecological development.

Water and soil conservation in the middle reaches: implement ecological protection and restoration projects for mountains, rivers, forests, fields, lakes and grass in key areas such as Hetao Plain, Fenwei Plain, Loess Plateau land desertification area, the Inner Mongolian Plateau lake atrophy and degradation area. We will strengthen the protection and restoration of the ecological environment in the Qinling Mountains, strengthen the protection and restoration of the habitats of rare and endangered species, actively promote the construction of ecological corridors, and expand the Lebensraum of wildlife.

The lower reaches study and prepare the conservation and restoration plan of Yellow River Delta wetland, and plan to build the Yellow River Estuary National Park. Ensure the ecological flow of estuarine wetlands, create conditions to steadily promote ecological water replenishment projects, connect the estuarine water system, and expand the area of natural wetlands.



Figure 5. Ecological protection and high-quality development planning in the Yellow River Basin

4.2. Full lifecycle supervision

The ecological protection and restoration of mountains, rivers, forests, fields, lakes, and grasslands require long-term monitoring and evaluation of ecosystem changes, full lifecycle monitoring, and timely adjustment and optimization of practical measures to achieve adaptive management.

The management of mountains, rivers, forests, fields, lakes, and grass systems must consider scale and level. The principle that "mountains, rivers, forests, fields, lakes, and grasses are a community of life" is a fundamental principle for the natural resources department to carry out ecological protection and restoration work in national land and space. Since 2016, China has carried out 25 pilot projects for ecological protection and restoration of mountains, rivers, forests, fields, lakes, and grasslands. This exploration has played a positive role in maintaining national ecological security. The ecological protection and restoration of mountains, rivers, forests, fields, lakes, and grasslands has broken through the current three-year implementation deadline of engineering projects, conducting long-term monitoring and evaluation of ecosystem changes, and timely adjusting and optimizing practical measures to achieve adaptive management.

The management and supervision system for the management of mountains, rivers, forests, fields, lakes, and grass systems is an important component of the natural resource application system. It uses information technology to finely manage the entire lifecycle of land space ecological restoration projects, achieving scientific management and fine remediation of ecological restoration projects, and improving the modernization level of land space governance system and governance capabilities.

According to the concept of "a community of mountains, rivers, forests, fields, lakes, and grasses for life", a comprehensive regional and factor base plate data is constructed through data, laying a solid data foundation for scientific and effective land spatial ecological restoration work. Finally, the system provides integration and call interfaces for the national spatial basic information platform to achieve dynamic data access. Realize real-time sharing, dynamic monitoring, and real-time dynamic supervision of project related data.



Figure 6. Schematic diagram of the full lifecycle supervision platform for land space ecological restoration projects

5. Conclusions

China explored and promoted the transformation of ecological restoration from partial and single-factor restoration to comprehensive, multi-scale and multi-factor integrated protection and restoration and comprehensive management. Taking the ecosystem damaged or lacking stability and security in different spatial scales as the object, through the adjustment and optimization of the spatial structure of land elements, the repair and reconstruction of ecological functions, supplemented by Ecological engineering and other systematic measures in the medium and macro scale, to repair the ecosystem process and improve the governance activities of ecosystem services, and ultimately achieve ecosystem health, landscape ecological security and regional sustainable development.

References

- Amen, M. A. (2021). The Assessment of Cities Physical Complexity through Urban Energy Consumption. *Civil Engineering and Architecture*, 9(7), 2517–2527. <https://doi.org/10.13189/cea.2021.090735>
- Aziz Amen, M. (2022). The effects of buildings' physical characteristics on urban network centrality. *Ain Shams Engineering Journal*, 13(6), 101765. <https://doi.org/10.1016/j.asej.2022.101765>
- Amen, M. A., Afara, A., & Nia, H. A. (2023). Exploring the Link between Street Layout Centrality and Walkability for Sustainable Tourism in Historical Urban Areas. *Urban Science*, 7(2), 67. <https://doi.org/10.3390/urbansci7020067>
- Amen, M. A., & Nia, H. A. (2020). The Effect of Centrality Values in Urban Gentrification Development: A Case Study of Erbil City. *Civil Engineering and Architecture*, 8(5), 916–928. <https://doi.org/10.13189/cea.2020.080519>
- <https://www.genevaenvironmentnetwork.org/resources/updates/nature-based-solutions/IUCN> (not dated) IUCN Global Standard for NbS, <https://www.iucn.org/theme/nature-based-solutions/resources/iucn-global-standardnbs>
- https://www.worldwildlife.org/stories/what-are-nature-based-solutions-and-how-can-they-help-us-address-the-climatecrisis?utm_campaign=science&utm_medium=social&utm_content=link&utm_source=twitter
- https://www.xinhuanet.com/politics/2020-05/22/c_1126013586.htm
- <https://www.ipcc.ch/srccl/>
- 2021.A Catalogue of Nature-Based Solutions for Urban Resilience. World Bank, Washington, DC. © World Bank.
- Cook, J. and Taylor, R. (2020) Nature is an economic winner for Covid-19 recovery, World Resources Institute. www.wri.org/news/coronavirus-nature-based-solutions-economic-recovery
- Elmqvist, T., Setälä, H., Handel, S. N., Van Der Ploeg, S., Aronson, J., Blignaut, J. N., ... & De Groot, R. (2015). Benefits of restoring ecosystem services in urban areas. *Current opinion in environmental sustainability*, 14, 101-108.
- Zhang J, Chen H*, Ma Y H, Liu D, Liang X Y, Chen W T. Identification of priority areas for ecological restoration based on ecological security and landscape elements. [J]. *Environmental Science and pollution Research*, 2022,30(12): 35307-35325.