

Several Strategic Issues for the Construction of Ecological Civilization in Yangtze River Economic Belt

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Abstract: To support the construction of ecological civilization in the Yangtze River Economic Belt, the Chinese Academy of Engineering launched a major consulting project in 2019 titled “Study on Several Strategic Issues for the Construction of Ecological Civilization in Yangtze River Economic Belt.” Based on the project’s results, this paper summarizes the achievements of ecological civilization construction in the Yangtze River Economic Belt in terms of top-level design, green demonstration, ecological protection, and environmental improvement. It then analyzes its main challenges regarding territorial development, industrial layout, river – lake relationship, ecological security, energy development, and environmental risks. Further, based on the concept of a life community of mountains, rivers, forests, farmland, lakes, grass, and sand, this study proposes several strategic suggestions focusing on ecological space management and control, water ecosystem health, green and high-quality development, ecological protection and restoration, ecological agriculture and forestry development, ecological product value realization, and the ecological civilization governance system.

Keywords: Yangtze River Economic Belt; ecological civilization; ecological space; environmental quality; strategic issue

1 Introduction

As stated clearly in the report to the 19th National Congress of the Communist Party of China (CPC) [1], the construction of ecological civilization is vital to sustaining China’s development. The construction of the Yangtze River Economic Belt (YREB) is one of the three major strategies launched by the CPC Central Committee, encompassing 11 provinces (municipalities) such as Shanghai, Jiangsu, and Zhejiang. Discussing the strategic tasks of YREB for the construction of ecological civilization is strategically significant for overall national development, as is building YREB into an ecological civilization construction demonstration belt, a high-quality economic development belt, and a coordinated development belt with eastern, central, and western regions interacting and

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cooperating. With strong support from the CPC Central Committee and the State Council and the joint efforts of various localities and departments, these 11 YREB provinces (municipalities) have, since the 13th Five-Year Plan period, strengthened environmental governance and promoted comprehensive green economic and social transformation in an unprecedented manner; these are in terms of intensity, scale, and impact. By advancing protection and development simultaneously, there has been tremendous progress in regional ecological civilization and environmental protection. However, issues related to imbalanced ecological progress, such as intensive land development, a mismatch between industrial layout and ecological functioning, a singular energy structure, serious disturbance to the river–lake relationship, and many hidden environmental risks, remain prevalent. Building on existing studies, this study examines the nexus between protection and development, as well as the mechanism of joint protection and shared responsibility in YREB in the context of a life community of mountains, rivers, forests, farmlands, lakes, grasslands, and deserts. Then, we make strategic suggestions for ecological space management, improving water ecosystem health, accelerating green and high-quality development, initiating ecological protection and restoration, sustaining ecological agriculture and forestry, and enhancing ecological product value realization and ecological governance system, providing scientific decision support for fully implementing the YREB strategy and accelerating the construction of ecological civilization.

2 Achievements in the construction of ecological civilization in YREB

With a strong push from the CPC Central Committee and the State Council, as well as the concerted efforts of various localities and departments, groundbreaking steps have been taken to promote ecological progress and environmental protection in YREB, which are manifested in the following aspects:

2.1 Top-level design for ecological civilization construction

The CPC Central Committee, the State Council, and more than 10 ministries and commissions have promulgated a series of relevant laws and regulations, action plans, and policies. Among them are the *Yangtze River Protection Law of the People's Republic of China*, the *Outline of the Yangtze River Economic Belt Development Plan*, the *Outline for Regional Integrated Development Plan of the Yangtze River Delta*, the *Environmental Protection Plan for the Yangtze River Economic Belt*, the *Action Plan for Yangtze River Protection and Restoration*, and the *Opinions on Comprehensively Strengthening Judicial Guarantee for Ecological Progress and Green Development in the Yangtze River Basin*. "Three Lines and One List" (ecological protection red line, environmental quality baseline, resource utilization upper limit, and environmental access negative list) have been compiled and published for the 11 provinces (municipalities) along the Yangtze River. Mechanisms have also been set up for horizontal ecological compensation across and within these YREB provinces (municipalities). As such, a top-level design system has been put in place to supervise the construction of ecological civilization in the region.

2.2 Noticeable results in regional ecological protection and restoration

Over the past 10 years, the forest area increased from 26.7% to 44.38%, resulting in a 31.44% increase in forest coverage in the region. While the area of soil erosion decreased by 34.7%, the value of ecosystem services grew by 103.9%. With the adoption of a ten-year fishing ban on the Yangtze River in 2019, aquatic biological resources have been gradually restored, thereby curbing the trend of biodiversity degradation [2].

2.3 Continued improvement in regional environmental quality

In 2019, the water quality reached Grade I–III in 91.7% of the sections, an increase of 9.4 points compared to 2016. The percentage further rose to 96.3% from January to November of 2020. In contrast, the percentage of sections with water quality below Grade V decreased from 2.9 to 0.6%. In 2020, all water bodies were improved above Grade V for the first time, and 88.2% of functional water zones met the required standards. From a historical perspective, the water quality of the Yangtze River has reached its highest point in the last two decades and has remained at Grade II for two consecutive years, surpassing the national target, with zero dynamic state-controlled sections below Grade V. Compared to 2015, the average number of good days or above in 126 cities at the prefecture level grew by 4.2%, while the average regional concentration of PM_{2.5} dropped by 25% [3,4].

2.4 Steady progress of environmental governance projects

One of China's seven landmark battles against pollution is protecting and restoring the Yangtze River. The

Ministry of Ecology and Environment has established the National Joint Research Center for Environmental Protection and Restoration of the Yangtze River to actively explore new technologies, carry out on-site monitoring and guidance, and provide technical support for the uphill battle of Yangtze River protection and restoration. YREB provinces have received a total of 120.3 billion yuan in forestry and grassland transfer payments and 50.4 billion yuan in pollution control funds from the central government over the period 2018–2021. All this money went into supporting YREB provinces in their mission to strengthen ecological protection, restoration, and environmental governance. To enhance environmental governance on all fronts in the region, an extensive range of key projects have been implemented systematically, including urban sewage and garbage treatment, pollution control of heavy chemical industrial parks along the river, pollution control of ships and ports, agricultural non-point source pollution control, and pollution control of tailings ponds along the river.

2.5 In-depth implementation of special campaigns for environmental protection

The 11 YREB provinces (municipalities) have completed the ecological protection red lines delineating 144 zones oriented to six functions including water source conservation, biodiversity maintenance, soil and water conservation, and soil erosion control. A spatial pattern of ecological protection red lines comprising three zones and 12 belts has been established. The river (lake) chief system has been established in the provinces, cities, counties, and townships in the Yangtze River Basin to organize and lead the water resource protection, shoreline management, water pollution control, and water environment governance of rivers and lakes within their respective administrative areas. The Inspection Review and Green Shield campaigns of the Central Environmental Protection Inspection—as well as the special inspection and rectification campaign targeting ecological problems in the Yangtze River Basin—have yielded results. Three Lines and One List has been fully implemented by reflecting environmental protection requirements in every river and unit. The uphill battle to protect and restore the Yangtze River includes eight priority tasks: remediation of state-controlled sections below Grade V, investigation and remediation of sewage outfalls, Green Shield campaign, investigation and remediation of phosphate rock, phosphate fertilizers, and phosphorus pesticides, Waste Removal campaign, protection of drinking water sources, treatment of black and odorous water bodies, and improvement of sewage treatment facilities in industrial parks.

3 Major challenges to the construction of ecological civilization

3.1 Intense land development, leading to an increasingly acute urban man–land contradiction

The eastern section of the Yangtze River is more heavily developed than the western section, with average intensities of 0.73%, 2.28%, and 13.06% in the upper, middle, and lower reaches, respectively. Although the intensity of land development appears to be low in the upper and middle reaches, population density in most areas has already exceeded the carrying capacity of the vulnerable environment. Some provinces and cities have seen a sharp increase in the intensity of downstream land development, which has pushed the human settlement environment to the limit or close to the limit. Such high population density and land development intensity have exacerbated conflicts between people, land, resources, environment, and ecology [5,6].

3.2 Mismatch between industrial layout and ecological functioning, resulting in prominent environmental problems in some areas

Approximately 40% of the nation's heavy chemical industries—chemicals, pharmaceuticals, non-ferrous smelting and building materials—have been built along the Yangtze River. The most common of these are papermaking, food, chemical, and metallurgical companies cluster in the Chengdu–Chongqing urban agglomeration. Steel, non-ferrous metals, chemicals, and building materials companies are densely located in the middle Yangtze urban agglomeration. Chemical, thermal power, and shipbuilding companies, as well as ports and terminals, are highly concentrated in the Yangtze River Delta. The overconcentration of heavy chemical enterprises, with huge discharges of wastewater, waste gas, and solid waste, has caused significant environmental problems in the surrounding areas.

3.3 Grave disturbance to the river–lake relationship, increasing difficulty in flood control

The natural connection between the mainstream and tributaries of the Yangtze River, as well as between rivers and lakes in the Yangtze River Basin, has been seriously obstructed. Only the Chishui River maintains a natural

connection with the Yangtze River among the 437 tributaries with a drainage area larger than 1000 km². The number of lakes decreased from 102 to 3. The construction of flood detention and retention areas is behind schedule, while the embankments for tributaries and lakes do not meet high standards for flood control, leaving the flood control situation in the middle and lower reaches still grim. The supply and demand for water resources in this region are clearly seasonal. Dongting and Poyang Lake frequently dry up as the hydrological rhythm of lakes changes dramatically.

3.4 Brutal encroachment of ecological space, posing a serious threat to the ecological security

Over the past two decades, the YREB ecosystem pattern has changed dramatically. The urban area has expanded by 39.03%, occupying a significant amount of ecological land. Along the Yangtze River, spatial development is plagued by issues such as indiscriminate occupancy and abuse, overcrowding, and overuse. Dongting and Poyang Lake, as well as wetlands in the middle and lower reaches, have shrunk, hastening the arrival of the low-water season. Less than 20% of the Yangtze River mainstream consists of ecologically significant natural shoreline. The aquatic biodiversity index plummets to an all-time low of the zero-fish level. Many rare species are on the verge of extinction, including the Yangtze finless porpoise, a critical situation, and the Baiji, a Chinese river dolphin, has been declared functionally extinct.

3.5 Overloaded environmental carrying capacity, putting enormous strain on efforts to improve environmental quality

Environmental carrying capacity is generally at or near its limit in YREB. Regional water pollutant discharge remains exceptionally high, approximately four and five times that of the Huaihe and Yellow River Basin respectively. The region's water pollutant discharge per unit of land area is roughly double the national average [7]. The water quality of some tributaries of the Yangtze River has not yet improved, with total phosphorus being the primary pollutant in the Yangtze River. As livestock and poultry manure has not been treated and utilized promptly, agricultural and rural non-point sources pollution remains severe. Air pollution is particularly noticeable in key areas such as the Chengdu–Chongqing, Wuhan, and Changsha–Zhuzhou–Xiangtan urban agglomerations.

3.6 Singular regional energy structure, contributing to a significant conflict between energy development and ecological environment

The YREB energy structure is still dominated by coal, with little development and utilization of solar, bioenergy, and wind energy. Therefore, major urban agglomerations are under immense pressure to reduce the atmosphere's carbon emissions. This region has numerous water conservancy projects—including 24 100 small-scale hydropower stations. The Yangtze River's aquatic ecosystem has been severely harmed by excessive and uncontrolled hydropower development. Therefore, a large number of water diversion-based power plants have reduced or even stopped river water flow. Revenues from power generation may not be sufficient to compensate for losses caused by environmental damage to waters.

3.7 Many hidden environmental risks, adding pressure on drinking water safety

Along the mainstream and tributaries of the Yangtze River are numerous businesses with a high environmental risk profile. Approximately 30% of enterprises with the potential to harm the environment are located within five kilometers of drinking water sources. Concentrated sites for critical pollution source production, storage, and transportation are interlaced with drinking water sources. The middle and lower reaches of urban water intake have a risky layout because of the staggered layout. Water environmental safety is threatened by several factors, including an increase in the volume of hazardous chemicals being transported.

3.8 A lack of modernization in the ecological governance system and capacity

In varying degrees, development trumps protection in local governance along the Yangtze River, impeding the full execution of responsibilities. Administration for shoreline environmental protection is inadequate because of unclearly defined responsibilities. For example, because the working rules of the ecological environment and natural resources departments have not yet been determined, the accountability and supervision mechanisms for environmental protection are unlikely to take effect in the real sense. Ecological governance is not without its flaws because it lacks a proper mechanism for coordinated environmental governance and central-to-local integration and

coordination of efforts. The construction of market-oriented, diversified ecological compensation mechanisms is slow. Further, the capacity of targeted, scientific, and intelligent environmental governance still needs improvement.

4 Strategic suggestions for the construction of ecological civilization

4.1 Optimizing the territorial spatial pattern and establishing a unified ecological space management system to create a favorable living environment

4.1.1 Comprehensive planning of diverse ecological spaces

The *Territorial Spatial Planning for the Yangtze River Economic Belt* and the territorial spatial planning of the provinces, cities, and counties alongside should be issued as soon as possible to allow for coordinated planning for various ecological spaces. A monitoring, evaluation, and early warning mechanism for ecological space is also required. By delineating ecological space, agricultural and urban space, and implementing the red lines for ecological protection and permeant basic farmland and the boundary for urban development, a unified and coordinated ecological space management system [8] should be implemented.

4.1.2 Strict regulation of the natural shoreline

Implementation of the *Integrated Plan for the Protection, Development, and Utilization of the Yangtze River Shoreline* must be rigorous. Areas for shoreline protection, reservation, control, and development should be scientifically defined, with clearly defined binding indicators such as the preservation rate of natural shoreline, the utilization rate of flood retention areas, and the restored length of ecological buffer zones of rivers and lakes. The one-size-fits-all practice of relocating businesses within one or five kilometers of shoreline is strictly prohibited. A sound coordination mechanism is essential for protecting, developing, and utilizing Yangtze River shorelines. It is crucial to strengthen the economical and intensive use of shoreline resources, establish a payment-based use system, and conduct regular central environmental protection inspections of the natural coastline.

4.1.3 Effective improvement of urban green space

The spatial layout of urban agglomerations can be optimized through the provision of differentiated guidance for upper, middle, and lower reaches, as well as for large, medium, and small cities [9]. The *Green Infrastructure Plan for the Yangtze River Economic Belt* should be formulated. An urban layout model of nesting ecological green centers and partitions into urban spaces will be created to facilitate the coexistence of humankind and nature in harmony.

4.2 Promoting green and high-quality development from an industry-energy perspective

4.2.1 Available development space for green industries

The direction, layout, and intensity of industrial development must be rationally determined [10,11], with resource and environmental carrying capacity, ecological function orientation, and ecological space as rigid constraints. Along the Yangtze River, projects involving riverside aquaculture, petroleum processing, chemical raw materials and chemical product manufacturing, and pharmaceutical manufacturing will be subject to stringent regulation, thereby forcing the green transformation of heavy chemical industries.

4.2.2 Green development of the petrochemical industry in all respects

With a particular focus on ecological management, the *Action Plan for Green Development of the Petrochemical Industry* should be fully implemented. This includes optimizing industrial layout to regulate industrial parks, improving green standards, fostering a system for green technology innovation, and launching green demonstration projects.

4.2.3 A differentiated strategy for low-carbon energy development

Scaling up power transmission and developing renewable energy according to local conditions will reduce coal's share in primary energy consumption. The upper reaches of the Yangtze River should further facilitate the production and consumption of renewable energy. The middle reaches should provide external energy transfers commensurate with local demand. Utilizing technological advantages, downstream regions can investigate large-scale and distributed energy combinations.

4.2.4 New highland for the green transformation of industrial parks

Guiding Opinions on Green Development of Industrial Parks in the Yangtze River Economic Belt should be provided, emphasizing downstream industrial parks' exemplary and leading roles in green development [12,13]. The

green, low-carbon industrial park transformation should be accelerated by intensifying the pollution control campaign for chemical parks along the Yangtze River and building green industrial parks throughout their life cycle. While a whole-process management system is essential, it is necessary to promote the digital and ecological management of industrial parks and enterprises to refine and intelligently manage and operate them.

4.3 Advancing flood control and safety in a coordinated manner and regulating the river–lake relationship to protect the health of water ecosystems

4.3.1 Up-to-standard construction of significant flood retention and detention areas and early revision of the *Flood Control Plan for the Yangtze River Basin*

At the national level, the National Development and Reform Commission, the Ministry of Water Resources, and the Ministry of Natural Resources should coordinate to ensure that major flood retention and detention areas with a high probability of use meet the required standards in the drainage areas of Dongting and Poyang Lake. Given the new water and sediment conditions in the middle and lower Yangtze River and main flood control issues that have surfaced in recent years, relevant departments, experts, and scholars will be assembled to review verifications and arrangements over flood control standards for the middle and lower Yangtze River, flood control water level in key areas, and major flood control projects. The *Flood Control Plan for the Yangtze River Basin* requires immediate revision and improvement.

4.3.2 Ecological regulation, restoration, and reconstruction to restore flagship species and endemic fish populations in the Yangtze River

Ecological regulation should be incorporated into the rules of reservoir regulation and the regulatory responsibilities of river basin administrations, extending its scope to cascade rivers in the upper reaches of the Yangtze River. The natural flow will be restored to restore endemic fish habitat in upper Yangtze tributaries rich in this kind of fish species and connected to cascade development sections. The Chishui River Water Ecological Protection Demonstration Zone will be established, and the habitat restoration and reconstruction pilot program will be launched in major tributaries such as Qingyi, Anning, and Shuiluo River. Targeting lakes with an important ecological status in the middle and lower reaches of the Yangtze River, pilot projects of river-lake connection restoration will be executed with a relatively small amount of labor.

4.3.3 Important structural measures to regulate the river–lake relationship scientifically

The Yangtze River’s ability to divert into Dongting Lake during the low-water season will be restored through the comprehensive improvement project for water systems north of Dongting Lake, which focuses on dredging the Songzi, Hudu, and Ouchi River. Per the principles of “building sluices but not dams and “serving low-water regulation but not flood control,” Poyang Lake’s outflow will have a water conservation project built at its exit to raise the lake’s minimum water level. Through scientific regulation and restoration of the river–lake relationship, a wetland environmental pattern that is compatible with habitats for wintering migratory birds.

4.4 Harmonizing ecological protection and restoration with ecological agriculture and forestry

4.4.1 Green ecological corridor comprised five shields and six lakes

A robust ecological security pattern with the river–lake harmony will be built in the region, taking into account the abundant and diverse ecological elements of rivers, lakes, and reservoirs, as well as the undulating and varied topography of mountains, rivers, and hills. Under this pattern, key ecological functional areas such as the Hengduan Mountains in southwest China serve as necessary shields, while major lakes such as Dianchi, Dongting, and Poyang Lake serve as key nodes. Such an ecological corridor consisting of six shields and six lakes will serve as the ecological axis to ensure the sustainability and stability of the national ecological security pattern.

4.4.2 Policy innovation driven by the legislation of the *Wetland Protection Law*

A long-term mechanism should be put in place for the national program of converting farmlands to forests and grassland. Raising the compensation standard for returning farmlands to grasslands, establishing stable ecological farms and pastures, and determining the industrial scale based on ecological thresholds is critical for the middle and upper reaches. In addition to improving subsidy standards, a compensation mechanism for ecological public welfare forests based on forest stand quality standards is mandatory. With the start of legislative work on the *Wetland Protection Law*, the ecological protection red line will be delineated for wetlands in the region.

4.4.3 Projects for the preservation and restoration of essential ecosystems

A range of major projects will be launched to expand the scope of ecological conservation and enhance the functions of important ecosystems; these include ecological restoration and conservation of ecologically vulnerable areas in the upper reaches of the Yangtze River, quality and efficiency improvement of ecological public welfare forests in the middle reaches, and wetland restoration in the middle and lower reaches by transforming farmlands into wetlands, aquaculture areas into wetlands, and flood detention areas into lakes.

4.5 Facilitating the value realization of ecological products without compromising on regional ecological fairness

4.5.1 National comprehensive experimental zones for value realization of ecological products

In ecological functional areas such as Sanjiangyuan, the Qinba Mountains, the Three Gorges Reservoir Area, Danjiangkou, the Wuling Mountains, the southern Anhui mountains, and the Yunnan–Guizhou Plateau, national comprehensive experimental zones for the value realization of ecological products can be established. Moreover, major projects will be launched to improve ecological product supply capacity.

4.5.2 Market-based mechanisms for the realization of ecological product value

It is advisable to actively explore the establishment of innovative mechanisms for government-led, market-oriented ecological compensation [14]. A financial transfer payment system based on the effectiveness of ecological protection should be adopted so that reasonable returns can be obtained for protecting and restoring the environment. A corresponding price must be paid for destroying the environment. A cross-provincial trading system for a total quota of ecological resources in the Yangtze River Basin and a quota trading mechanism for ecological land development in upstream and downstream areas should be established while promoting the “land ticket” and “forest ticket” systems in Chongqing [15].

4.5.3 More support for the coordinated development of upstream and downstream areas

Establishing an inter-provincial remote development mechanism for upstream and downstream areas is required to facilitate the joint offsite construction of industrial parks by economically developed downstream provinces (cities) and upstream key economic development areas. To broaden the scope of support, an intro-provincial coordinated development mechanism and a downstream-upstream paired assistance mechanism are also mandatory.

4.6 Building a new governance system for developing ecological civilization, characterized by policy consultation, capacity co-building, and responsibility-sharing

4.6.1 Green domestic product-oriented evaluation and assessment mechanism

It is crucial to establish a sound legal system and governance mechanism to build an ecological civilization based on the *Yangtze River Protection Law*; this includes the strictest environmental accountability system, law-based in-depth central environmental protection inspection, the natural resources asset audit of off-office cadres, and the life-long accountability system concerning environmental damage. Political performance should have a scientific perspective so that green domestic product, gross ecosystem product, and green development indicators can act as a baton in performance appraisal. The river and lake chief system should be further implemented.

4.6.2 Green Fund for Yangtze River Environmental Protection

While advancing the construction of the green financial system, the Green Fund for Yangtze River Environmental Protection should be set up expeditiously, and differentiated preferential policies in tax payment and project financing and exit are expected to direct more social funds and capital to the Yangtze River's environmental protection.

4.6.3 “Smart brain” program for environmental protection

The Yangtze River Basin will establish a space–ground–air integrated environmental monitoring system [16], an intelligent digital environmental monitoring system, and an innovative smart environmental law enforcement model. In addition, the environmental quality prediction, forecast, and early warning system must be strengthened; a riverside environmental big data platform must be built.

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