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Promotion Strategy of Integrated Development in the Yangtze River Delta Region Based on Innovation-Driven and Green Development

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Abstract: How the Yangtze River Delta (YRD) region can achieve integrated development under the background of innovation-driven and green development is an important issue currently facing it. To solve this problem, this paper adopts the formulation of a detailed action plan and a number of integrated development strategies. This study aims to deepen the unified ecological and environmental protection system, establish a more efficient and smooth factor flow mechanism, improve the public service co-construction and sharing mechanism, accelerate the realization of ecological product value, and promote green production and living styles. At the same time, this study investigates the economic data of the YRD region in the past decade, analyzes the correlation between development factors and green development, and finds that the industrial structure index has the highest correlation with the level of green development, reaching 91.51%. This shows that if the YRD region wants long-term green development, it should focus on adjusting its industrial structure.

1. Introduction

The integration process of the YRD is attracting attention as the global engine of the Chinese economy and the vibrant global city group. Economic globalization and regional integration accelerated many opportunities and challenges. How to achieve green development amid rapid economic growth has become the key to the integrated development of YRD [1]. In recent years, YRD has made remarkable achievements in science and technology, industrial upgrading, and environmental protection, but the deep integration of innovation-driven and green development still needs to be explored in depth. Past research has mostly focused on economic, transportation, and institutional integration, and research on the synergy between innovation-driven and green development is still insufficient [2].

Therefore this paper explores the importance of innovation and green development in regional development by analyzing the impact of YRD regional development factors on the development of

the region, so as to provide new theoretical perspectives and practical guidance for regional integrated development. First, through literature review and field research, the study sorts out the historical context, current characteristics, existing problems and challenges of the integrated development of the YRD region; secondly, based on the theoretical framework of innovation-driven and green development, an analytical model of the integrated development of the YRD region is constructed, and the core variables and indicator system of the study are clarified; then, statistical analysis methods are used to conduct an empirical analysis of the relationship between innovation-driven and green development in the YRD region, revealing the inherent connection and interaction mechanism between the two; finally, the research conclusions are summarized and discussed, and the prospects and directions for future research are proposed. This paper strives to make breakthrough progress in revealing the integration path and coordination mechanism of innovation-driven and green development in the regional integration of the Yangtze River Delta, in order to provide a useful reference for regional economic and social development.

2. Related Works

Against the backdrop of globalization and sustainable development, regional integration and green innovation have become important engines for promoting economic and social progress. In recent years, many scholars have explored the theory and practice in this field from different angles and levels, providing valuable references for policymakers and practitioners. Wu and Sun proposed the theoretical and practical link between regional integration and sustainable development in YRD, emphasizing the importance of interdisciplinary, cross-regional and multi-scale research, and providing new perspectives for related studies [3]. Luo et al. analyzed the impact of China's digital economy on green innovation by identifying facilitative and spatial spillover effects [4]. Ullah et al. found that green innovation in Pakistan's manufacturing sector is mainly driven by cost reduction and government support revealed [5]. Lee et al. studied the impact of China’ s environmental regulations and innovation capabilities on green total factor productivity and found that both can promote green growth, and that innovation capabilities play a mediating role between environmental regulations and green growth[6]. Udeagha and Muchapondwa analyzed the environmental impact of financial technology in BRICS countries and proposed the development of environmentally friendly financial products [7].

The above studies have explored innovation-driven and green development, but there are still deficiencies. Some studies lack specific implementation and interdisciplinary integration, and there is insufficient analysis of regional differences. Focusing specifically on the specific region of YRD, this paper aims to propose more targeted and practically valuable strategies for integrated regional development. By analyzing the actual situation of the YRD region in depth, this paper is expected to provide more comprehensive and in-depth insights into the regional integration and sustainable development of the YRD, and thus make up for the shortcomings of current research.

3. Methods

3.1 Connotation of Ecological Civilization

Ecological civilization, as a composite concept formed by the fusion of "ecology" and "civilization", is interpreted in both a broad and a narrow sense. In a broad sense, it is on a par with primitive civilization, agricultural civilization and industrial civilization, representing a new stage in the development of human society, emphasizing the respect for nature and the maintenance of ecological balance, and aiming at the harmonious coexistence of human beings, nature and society through the adjustment of human production and life styles [8]. The broad understanding of

ecological civilization includes political, economic and cultural aspects. In the narrow sense, it focuses on the components of social civilization, corresponding to material civilization, spiritual civilization and political civilization, and is regarded as an indispensable part of the modern civilization system, constituting its foundation. Ecological civilization in the narrow sense focuses on the use of natural resources while implementing conservation measures, advocating ecological protection, advocating the prevention of environmental pollution, and stressing the establishment of a comprehensive ecological concept, with the aim of optimizing the relationship between human beings and nature and promoting the harmonious coexistence of the two. This paper adopts the definition of ecological civilization in the narrow sense as an important component of social civilization, and discusses the YRD regional integration development strategy around this theme.

3.2 The connotation of the Integrated Development of Innovation-Driven and Green Development

Within the larger framework of social civilization, ecological civilization plays a central role alongside material, spiritual and political civilization [9]. Its core ideas are the implementation of the concept of green development, adherence to the equal importance of conservation and environmental protection, efforts to prevent pollution and restore ecosystems, and the pursuit of the ideal of harmonious coexistence between man and nature [10].

1). Coordinated promotion of economic development and environmental protection

Development is driven by technological and knowledge-based innovation to enhance the quality and overall effectiveness of economic development. The core of green development lies in effective environmental protection in the development process, which ensures harmonious coexistence and synergistic development of man and nature. The integration of innovation and green development is mainly to guide the economy to achieve a quality development process and at the same time strengthen ecological environment protection, ultimately achieving that economic development and environmental protection promote and complement each other, realizing synergies between them and going hand in hand.

2). Promoting technological innovation and green transformation

Innovation-driven development provides strong technical support and solutions for green development. Through technological innovation, more environmentally friendly materials, energy and technologies can be developed to promote the transformation and upgrading of industries towards green and low-carbon development. At the same time, green development has also opened up new areas and directions for technological innovation and promoted the continuous progress and upgrading of technology [11].

3). Achieving sustainable development goals

The ultimate goal of integrating innovation-driven development with green development is to achieve the vision of sustainable development. This means that we need to make every effort to promote an ideal state of coordination and balance among economic growth, social progress and environmental protection. We must not only ensure that the various needs of contemporary people are fully met, but also reserve sufficient development space and resources for future generations so that they can meet their own needs without obstacles in the future, thus building a human social development model that is passed down from generation to generation, has a virtuous cycle and is sustainable.

3.3 YRD Development Strategy

1). Innovation-driven strategy

During the development process, the concept of innovation should run through the entire process

of development, through increasing investment in scientific and technological research and development, improving and optimizing the innovation ecological environment, and actively absorbing and cultivating high-end innovative talents; improving the innovation level of the YRD region, creating an innovative thought demonstration zone to drive the development of surrounding areas.

2). Green development strategy

We must deeply integrate the concept of green development into all aspects of the economy and society, optimize the industrial structure and promote the green transformation of traditional industries; develop green industries to form a cluster effect, strengthen green technology innovation and transformation of results; at the same time, promote its application in multiple fields to reduce energy consumption and emissions, ensure that green concepts run through the entire development process, and promote the sustainable and healthy development of the green economy.

3). Regional cooperation and coordinated development

In the development process of regional integration in the YRD, regional cooperation and coordination are undoubtedly at the centre, and their critical nature needs to be further highlighted and strengthened. The YRD region should promote co-operation in all aspects and at all levels in several key dimensions, such as policy communication, facility connectivity, smooth trade, financial integration and people-to-people communication, so as to shape a good pattern and situation in which the advantages of different places complement each other and the whole region develops in a synergistic manner.

4. Results and Discussion

4.1 Survey on the Current Status of Ecological Environment in the YRD Region

The study investigated the ecological development of the YRD region between 2011 and 2021 to determine the green development status of the region, and the specific findings are presented in Figure 1.

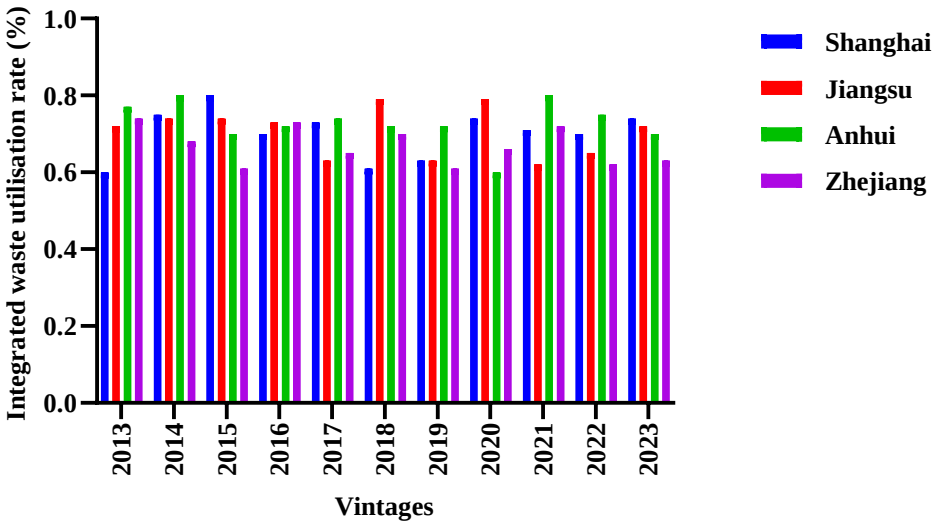

Figure 1: Municipal solid waste utilization in YRD region

According to Figure 1, it can be seen that the construction of ecological and environmental infrastructure in the region has fluctuated, with some years of decline, but the recycling rate in each province is between 0.6 and 0.8 in most years, which is effective but also effective in achieving a

higher level of green development. It is clear that strengthening is needed to achieve a higher level of green development. Next, the status of energy conservation and emission reduction in the YRD is examined in detail, taking into account urban electricity consumption, waste generation and air quality.

Table 1: Energy conservation and emission reduction in the YRD region

Sports event		Shanghai	Jiangsu	Anhui	Zhejiang
Urban electricity consumption	Annual total electricity consumption (10^8 kWh)	1547	6121	3534	4871
	Per capita electricity consumption (kWh/person)	10122	7507	6247	7218
	Industrial power consumption (100 million kWh)	815	3817	2236	3156
	Residential electricity consumption (10^8 kWh)	545	1467	924	1274
Waste discharge volume	Annual total waste discharge (10^4tons)	325	1246	801	1167
	Industrial waste emissions (10^4 tons)	217	827	550	727
	Domestic waste discharge volume (10^4 tons)	85	304	215	251
Urban air quality	Annual average concentration of PM2.5 (micrograms/cm^3)	37	48	45	35
	Annual compliance days	124	195	231	174
	Annual Average Air Quality Index (AQI)	76	81	85	75
	Annual average concentration of PM10 (micrograms/cm^3)	56	61	76	68

Table 1 then analyzes the YRD Eco-Development Index, which takes into account the balance between economy and environmental protection and reflects the extent to which the region implements the concept of ecological protection and sustainable development.

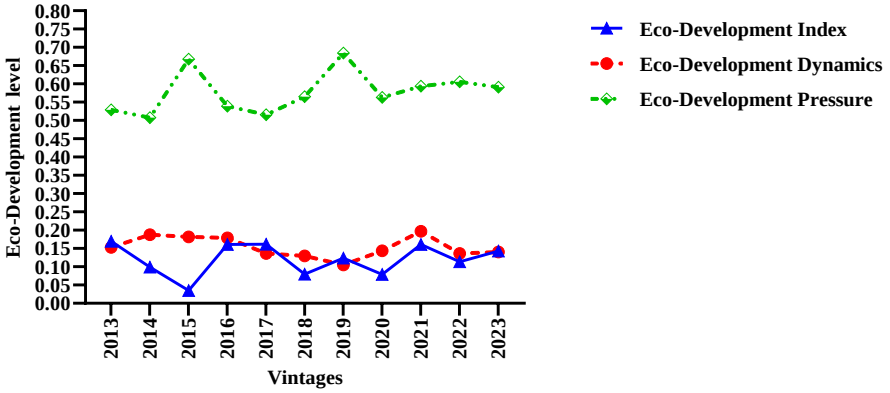

Figure 2: Ecological environment level in the YRD region

According to the data in Figure 2, the ecological development index of the region has shown an overall fluctuating trend, but has increased in recent years. In terms of ecological development momentum, the index fluctuates year by year but has increased slightly overall, indicating that the

force driving ecological development is increasing. However, the ecological development pressure index remains high, especially in 2015, 2019 and 2022, all exceeding 0.6, reflecting that environmental protection still faces great pressure.

4.2 Analysis of the Factors of Integrated Development

The data for this study is derived from the National Bureau of Statistics 2023 China Urban Statistical Yearbook. For some of the missing data and rejected outliers, linear interpolation was applied to fill in the blanks. The descriptive statistics of each variable are presented in Table 2.

Table 2: Statistics of development variables

Variant	Meaning	Average value	Standard deviation	Median	Maximum values	Minimum value
DIG	Digital Economy Development Index	0.139	0.35	0.087	0.712	0.011
IND	Industrial Structure Index	1.002	0.413	0.975	2.643	0.294
PGDP	Per capita GDP	102846.511	41211.312	101344	250912	19245
TEC	Proportion of technology expenditure	0.039	0.019	0.037	0.112	0.007
ENV	Proportion of environmental protection expenditure	0.043	0.021	0.041	0.134	0.009

Subsequently, this study used the data in Table 2 to deeply analyze the correlation between each variable and the green development of the YRD region, and the results are intuitively presented in Figure 3.

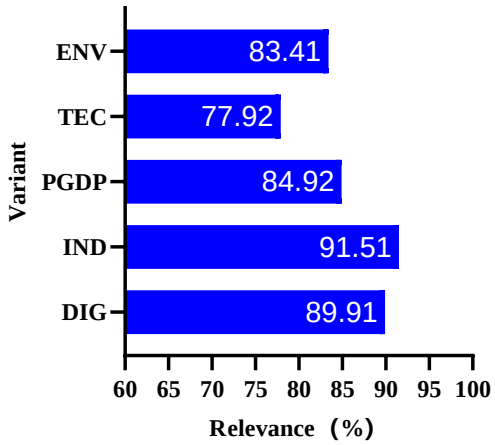

Figure 3: Correlation of various variables with the development of the YRD region

According to the results in Figure 3, there is a positive correlation between the different urban characteristics variables and the level of green development of the region. Among them, the industrial structure index (IND) has the highest correlation with the level of green development, reaching 91.51%, indicating that industrial development has an important impact on the green

development of the YRD region. The Digital Economy Development Index (DIG) and Per Capita GDP (PGDP) are also highly positively correlated with green development, reaching 89.91% and 84.92% respectively, indicating that the digital economy and economic development level play a significant role in promoting green development. In addition, technological innovation capability (TEC) and environmental protection investment (ENV) are also highly correlated with green development, reaching 77.92% and 83.41% respectively, indicating that technological innovation and environmental protection investment are important factors in promoting green development in the YRD region.

5. Conclusion

The study explores the development factors of the YRD region in terms of innovation-driven as well as green development, and finds that innovation-driven and green development are the key elements to promote the integrated development of the region. However, the study also acknowledges that there are certain limitations, such as the limited data samples and the possible complex relationships between variables. Based on this, the study recommends that the YRD region should continue to strengthen innovation-driven development, improve the level of green development, and deepen the regional integration and cooperation mechanism to achieve more sustainable and balanced development.

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