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Research on the Reconstruction of Village Settlement System in the Context of Urban-Rural Integration and Transformation

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Abstract: - This study aims to explore the reconstruction of village and town settlement system in the context of urban-rural integration and transformation. It emphasizes the importance of balanced development and integration by analyzing the evolution patterns and optimization strategies of village and town settlements in the context of urban-rural transformation. The study employs geo-detectors and spatial analysis methods to identify key factors affecting the evolution of settlements, such as economic development, policy support, and geographic location. The results reveal a variety of settlement reconfiguration models for urban-rural integration and highlight the role of policy and economic factors in the formation of settlement systems. The study provides innovative perspectives on urban-rural integration with recommendations for promoting sustainable development through policy adjustments and targeted interventions.

Keywords: urban-rural integration; transformational development; township settlement; Yinzhou District; system evaluation

1. INTRODUCTION

China's widely dispersed village and town settlements constitute its basic living environment, and these settlements play a central role in sustaining the country's habitat. In the face of long-standing development imbalances under the dual system of urban and rural areas, the promotion of integrated urban and rural development has become a key objective in adjusting and optimizing urban-rural relations. Since the late 1990s, in response to the socio-economic situation at that time, China has put forward an initial concept of integrated urban-rural economic and social development, known as the "urban-rural integration" strategy. This strategy has subsequently been further developed and deepened, and has been gradually implemented in practice; to date, China has established a basic framework for integrated urban-rural development. According to the assessment of the quality of urban-rural integration across the country, the more economically developed regions perform better in terms of urban-rural integration and development, especially in terms of the high mobility of factors such as capital, labor, and technology, and the rapid rate of industrial agglomeration, which is conducive to the formation of hi-tech industrial parks, and further facilitates the effective integration of various types of factors. In the current context of integrated urban and rural development, how to effectively promote the integrated use of urban and rural resources has become an important challenge for economically developed regions.

Village settlements are not only important carriers of regional environment and culture, but their development and evolution process also profoundly maps the influence of multiple factors, such as the natural environment, social culture and policy orientation. With the continuous evolution of the economic and social environment, the form and structure of the village and town settlement system have been influenced and constrained by many factors, showing diversified types and complex structural characteristics. Therefore, an in-depth study of the evolution path of the village settlement system and its optimization strategy can not only reveal the characteristics and internal power mechanism in the process of its change, but also has significant theoretical and practical value in guiding the construction and development of future village settlements. Through such research, scientific planning and

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suggestions can be provided for the sustainable development of village and town settlements, further promoting the harmonious development of social economy and environmental protection.

2. RELEVANT THEORETICAL FOUNDATIONS AND LITERATURE REVIEW

2.1 Relevant theoretical foundations

2.1.1 Agglomeration-diffusion theory

Originally used to describe a basic law of economic development, the theory of agglomeration-diffusion was applied by Prof. Zhang Guohong to the analysis of regional economic development, arguing that agglomeration and diffusion are two key dynamic forms of regional economic evolution. The agglomeration effect describes the phenomenon of concentration of resources and factors in regions with more mature economic development, while the diffusion effect refers to the flow of these factors from developed regions to less developed regions. There is a tipping point between agglomeration and diffusion, the determination of which is important for promoting balanced regional economic development. Excessive agglomeration or diffusion may adversely affect regional development [1-2].

Over time, agglomeration-diffusion theory has also been extended to the field of urban development, becoming an important tool for analyzing the development patterns of metropolitan clusters and urban agglomerations. The theory states that the development process follows a similar agglomeration-diffusion pattern, both at the macro-level of urban agglomerations and in the more subtle units of urban-rural integration. In the context of urban-rural integration, the theory provides a powerful analytical framework for understanding and guiding economic activity and development within counties and between counties and neighboring regions. The growth and evolution of the urban-rural integration development unit, as a spatial geographic unit of county development, also needs to go through the process from agglomeration to diffusion, a process that plays a key role in realizing economic balance and social harmony within the region.

2.2.2 Growth pole theory

The theory of growth poles, first proposed by French economist François Peloux in 1955, breaks through the traditional notion of the uniform distribution of economic growth, pointing out that economic growth tends to be concentrated in specific regions or industrial centers, forming the so-called "growth poles". These growth poles, because of their development potential and radiation effect, can drive the industries and economy of the surrounding areas to improve as a whole, demonstrating the unbalanced nature of regional development. The growth pole theory emphasizes that through the government's strategic investment in regions or industries with development potential, it can lead to the agglomeration effect of cities or industries, and these agglomeration centers can then promote the common progress of the surrounding areas through their strong economic influence [3].

The growth pole theory is equally instructive in explaining the development strategy of urban-rural integration. Under the framework of urban-rural integration, village and township settlements can be regarded as the basic growth poles within the development unit. These clusters or centers promote their own economic and social development firstly by gathering resources and activities, and then stimulate and drive the development of the surrounding village areas through the diffusion effect, so as to achieve a balanced and comprehensive enhancement of the whole development unit [4]. Therefore, the strategy of optimizing the urban-rural integration development unit should focus on how to enhance the driving role of the central cluster, ensure that it can effectively radiate and promote the comprehensive development of the hinterland areas, and then achieve the purpose of enhancing the overall regional development level.

2.2.3 Theories of rural community development

The introduction of the concept of community to China can be traced back to the 1930s, when it was first proposed by the scholar Fei Xiaotong, marking the recognition of a community of social life based on shared emotions and will. Rural communities, in particular, have taken a shape that has been largely influenced by the reform of China's rural economic system, especially the implementation of the household contract responsibility system, which has dramatically changed the mode of production and life in rural areas [5]. However, this change has been accompanied by the lagging behind of the rural social management system, a situation that has further exacerbated the gap between urban and rural residents. In response to this problem, in 2006, the Sixth Plenary Session of the 16th Central Committee of the Communist Party of China (CPC) listed the construction of rural communities as a core element of the national development strategy, and since then, many parts of the country have begun to explore the construction of rural communities, resulting in a series of implementation guidelines [6-7].

The concept of a new rural community was proposed in the course of promoting the construction of new rural areas, with the aim of promoting integrated urban-rural development by planning and integrating a number of natural or administrative villages through centralized living, the support of a modern industrial system and the introduction of an urbanized lifestyle. The concept was proposed to address the differences between traditional rural communities and urban communities in terms of low population density and low mobility, etc. By constructing centralized residential areas with small towns or central villages as the core, it not only reduces the gap with urban communities in terms of the configuration of public service facilities and the improvement of the living environment, but also serves as an effective way of realizing urban-rural integration and promoting social equity [8].

Therefore, for the optimization of the village and town settlement system, the experience and strategy of the development of new rural communities should be absorbed, and through the integration of the village and town system within the urban-rural integrated development unit to the new rural community level, aiming to improve the efficiency of production and life, realize the integrated development of urban and rural areas, and optimize the relationship between human beings and the land [9]. This process involves not only the reconfiguration of physical space, but also the innovation of social management and economic development model, as well as the strengthening of cultural identity, which together promote the comprehensive integration of urban and rural development.

2.2 Key concepts

2.2.1 Integrated urban and rural development

The concept of urban-rural integration has its roots in the nineteenth century, when Marx and Engels, in response to the imbalance between the division of labor and the development of productive forces in society, explored the urban-rural differences and antagonisms that this phenomenon raised. They argued that the pursuit of rapid urban development in Western capitalist countries had exacerbated the conflicts between urban and rural areas. Marx further suggested that with social progress, the antagonism between urban and rural areas would gradually ease and eventually achieve integration, foreseeing the development trend of urban-rural relations. The concept of urban-rural integration and development has thus become the focus of extensive academic attention, but there are different interpretations of its specific definition due to differences in research perspectives and regions. On the whole, urban-rural integration is mainly reflected in the following aspects.

First, the "idyllic city" theory. The "idyllic city" theory proposed by Howard is one of the early manifestations of the concept of integrated urban-rural development, which aims to create a living environment that is convenient to the city while retaining the tranquillity and green space of the countryside. By comparing the city, the countryside and the rural-urban interface to three magnets, Howard visualized the close connection and interdependence

between urban and rural areas. The idea of the idyllic city is based on the principle of urban-rural complementarity, aiming to realize the harmonious coexistence of residential areas and agricultural land, and defining the boundary between the city and the countryside through a certain area of permanent green belt. The model's urban design is circular, with an urban settlement at its core, connected to the surrounding countryside by radial roads, and the entire idyllic city is expected to encompass about 6,000 acres and accommodate about 32,000 people. Howard further envisioned that multiple idyllic cities could form a cluster of cities, with a larger central city of up to 58,000 people, which would be interconnected by transportation arteries, economically independent, politically allied, and culturally connected. This layout aims to promote balanced development between cities and villages, and to reduce the pressures and problems faced by traditional large cities by decentralizing urban population and industries, while preserving the natural environment and social structure of rural areas. Howard's idyllic city concept emphasized the integration and interaction between urban and rural areas, reflecting a deep understanding of the problems of over-concentration in cities and desertion in the countryside. His theory has not only had a profound impact on subsequent urban planning and development, but has also provided an important theoretical foundation and practical guidance for understanding and promoting urban-rural integration.

Second, the theory of urban-rural integration. In his study of several Asian countries and regions, Canadian scholar McGee observed a new spatial structure in which the boundaries between urban and rural areas were gradually blurred and urban and rural areas were increasingly connected, a phenomenon he summarized as the "Desakota" theory. "desa" means countryside and "kota" means town, directly translated as "urban-rural" or "rural-town". "The term is intended to describe a mixed region that is both urban and rural in character. Such regions are characterized by a high degree of integration of agricultural and non-agricultural activities along transportation corridors around the core of a large city, exhibiting urban-rural coexistence [10].The Desakota model is particularly applicable to metropolitan areas and their surroundings in Asia, and the theory has further given rise to the concept of "mega-urban region". " concept. According to McKee, a mega-urban region consists of at least two or more core cities connected by an efficient transportation network, encompassing the core city, the peripheral urban areas, and the Desakota region. The concept of metropolitan belt emphasizes the continuity and interaction between cities and villages, pointing out that modern urban and rural development is no longer isolated, but a complex system of interdependence and interpenetration. McKee's Desakota theory and the concept of metropolitan belt provide a new perspective for understanding urban-rural integration, emphasizing that in the context of globalization and rapid urbanization, the city and the countryside should be regarded as a whole [11-12]. This perspective reveals a shift from traditional urban expansion to urban-rural integration, emphasizes the close connection and interaction between cities and villages, and provides a more integrated and sustainable research paradigm for urban-rural development.

2.2.2 Urban settlement system

Human settlements and areas of activity are collectively known as "settlements", which, according to their nature of development, are divided into two main categories: urban settlements and rural settlements. Urban settlements refer to the residential areas of municipalities, cities, towns and other urban areas or townships that are divided according to the administrative structure of the State. In contrast, rural settlements, also known as village settlements, mainly refer to residential settlements located outside of urban areas and townships, covering market towns and villages and so on. Different disciplines have different names for rural settlements, such as geography, which usually uses the term "rural settlement", and planning, which tends to use the term "village settlement", but both essentially focus on the study of a specific living space corresponding to urban settlements. The village and town cluster system refers to the organic linkage of multiple rural clusters within a certain geographic area, from

the largest established town (or county-level city) to the smallest natural village, which constitutes the different levels of this system. This study focuses on the village and township settlement system within the county, including administrative divisions such as streets, formed towns, townships, administrative villages and natural villages, and concentrates on exploring the status of their economic and social development without going deeper into the analysis of specific settlement settlements.

The goal of optimizing the settlement system of villages and towns is to establish a settlement pattern of villages and towns that integrates urban and rural areas, and the main optimization paths include the following: firstly, according to the scale of development of villages and towns, spatial distribution, geographical functions and traffic arteries, constructing agglomeration axes and structural networks, and forming a hierarchical and orderly system of villages and towns; secondly, based on the principles of moderate agglomeration and comprehensive land improvement, and taking into account ecological environments, geographic locations and economic and social conditions, exploring the optimization mode of integrating production, living and ecological spaces. Secondly, based on the principle of moderate agglomeration and comprehensive land improvement, and considering the ecological environment, geographical location and economic and social conditions, explore the optimization mode of village and town settlement system that integrates production, living and ecological space. These optimization strategies aim to promote the sustainable development of villages and towns, improve the quality of life of residents, and promote the balanced and harmonious development between urban and rural areas [13].

The former focuses on the construction of theoretical models and the development of comprehensive evaluation indexes, aiming at assessing and analyzing the suitability, influence and land remediation potential of village and town settlement systems. With the help of the concepts of ecological location, locational potential and residential field potential, the research in this direction divides the development stages and types of settlement systems and proposes optimization directions and patterns through the establishment of indicator systems and measurement models. For example, using the theory of location potential to conduct quantitative analysis from the perspective of geographic location; using the ecological location suitability model and GIS technology to evaluate the land use of settlements; adopting the theory of residential field potential and metric method to construct the reconstruction mode of village and town settlement landscape space; introducing the theory of symbiosis to analyze the symbiotic system for the spatial reconstruction of the settlements; as well as improving the spatial interaction model for the classification of the structure of the township system and the division of the economic zones, etc. [14-16].

The latter focuses more on field application and exploration of optimization paths, analyzing the relationship between village and town settlements and land remediation, and attempting to identify settlement optimization methods applicable to specific regions. This includes systematic analysis of the spatial role mechanisms of village and town growth poles and development axes, identification of core settlements and spatial reconfiguration strategies using the gravity model, as well as comprehensive evaluation of the appropriateness of the construction and development of rural settlements, and realization of agglomeration and development of settlements through the optimization of spatial layout schemes. From different theoretical starting points and through the application of various technical means and models, these researches aim to provide scientific basis and practical operation paths for the optimization of village and town settlement system.

These two research directions have their own focuses, the former pays more attention to the construction of theoretical frameworks and models, as well as the comprehensive analysis of the settlement system through indicators and evaluation systems; the latter pays more attention to the practical application and implementation of optimization strategies, and explores the optimization paths of settlements suitable for a specific region through specific methods and models. The two complement each other and jointly promote the in-depth research on the

optimization of village and town settlement system, providing theoretical and practical support for the sustainable development and optimization of the settlement system.

3. METHODOLOGY

3.1 Identification of Impact Factors

The development and evolution of village settlements is a complex process influenced by a variety of factors, including natural topography, economic development, industrial layout, town planning, transportation construction and policy formulation. Among them, natural terrain, as a basic factor, has a long-term and stable influence on the formation and sustainable development of village and town settlements. While changes in socio-economic factors and policy environments act on the operation and development of village and town settlements in a more complex and variable way in a shorter period of time [17]. The driving factors that drive the development of village and town settlements with urban-rural integration are mainly manifested through spatial connectivity, economic interaction, and policy support. Therefore, this study focuses on the four key dimensions of location, economy, ecology, and society to analyze how they affect the process and outcome of urban-rural integration.

3.2 Reconstructing Dynamics Recognition

An in-depth understanding of the spatial organization patterns of village and town settlements and their evolution under urban-rural integration requires a comprehensive analysis of these influencing factors. Urban-rural integration is a dynamic process influenced by multiple factors such as geography, socio-economic conditions, transportation conditions, and policy frameworks. These factors work together in the spatial organization of urban-rural integration, but their respective influences and interactions may vary in different environments and stages.

Geodetector is an effective analytical tool based on the theory of spatial variability, spatial superposition techniques and set theory to determine the extent to which the independent variable factors influence changes in the dependent variable by comparing the spatial consistency of the dependent variable with the independent variable factors [18]. The tool can quantitatively reveal the extent to which the spatial heterogeneity of the dependent variable Y (e.g., the spatial organizational pattern of urban-rural integration) and the driving factors behind it, X (e.g., locational, economic, ecological, and social factors), explain this heterogeneity. q-values are used to measure the extent of such an explanation, and the expression reflects the strength of the independent variable's explanation of the spatial homogeneity of the dependent variable, thus providing a quantitative basis for the formulation of urban-rural integration strategies.

$$q = \frac{\sum_{h=1}^{L} N_{\hbar}\sigma_{\hbar}^{2}}{N\rho^{2}} \qquad (1)$$

Where:h represents the number of types of the independent variable; $N_{\hbar}$ and N denote the number of cells under the number of types h and the number of cells in the whole region, respectively; $\sigma_{\hbar}^{2}$ and σ^{2} are the method of the dependent variable Y in stratum h and the variance of the dependent variable Y in the whole region, respectively. The factor contribution power (q-value) ranges from 0 to 1, where a higher q-value indicates a higher contribution of the independent variable X to the dependent variable Y and vice versa. A q-value of 0 implies that the independent variable factors are completely unrelated to the dependent variable, whereas 1 implies that the independent variable factors are completely in control of the variance of the dependent variable.

In the analysis of multivariate interactions, there may be mutually reinforcing, mutually resisting, or mutually independent relationships among the independent factors X1, X2, etc. Through the application of geo-detectors, we are able to quantitatively identify and evaluate the degree of contribution of each relevant factor to the process of agglomeration and diffusion of village and town clusters, and objectively reveal the main factors affecting the evolution of village and town cluster system in the process of urban-rural integration and their interactions.

This quantitative analysis method provides a scientific basis for the development of village and town settlement system optimization and regulation strategies under the orientation of urban-rural integration. By accurately identifying which factors have a key impact on the development and evolution of village and town settlements, policymakers and planners can design strategies in a more targeted manner, taking into account the key drivers for development and also effectively responding to or adjusting those factors that may impede urban-rural integration, so as to achieve the optimization and sustainable development of the village and town settlement system.

After careful analysis of the annual change volume of typical sample construction land, we successfully extracted the relevant data and used it as the dependent variable Y for in-depth study. To ensure the accuracy and comprehensiveness of the analysis, we created a 300×300m layer of sampling points in Geographic Information System (GIS) for subsequent data processing and analysis.

In the study of urban-rural integration and optimization of village and town settlement system, careful selection of influencing factors is a key step to ensure the accuracy of factor detection. In this study, four major aspects, namely, location conditions, social conditions, economic conditions, and ecological conditions, are taken into consideration, aiming to comprehensively assess the influence of these factors on the development of village and township settlements. The location condition measures the geographical advantage and accessibility of the settlement by examining its distance from urban areas, major roads and highway off-ramps. Social conditions reflect the degree of population concentration of the settlement through population density indicators. Economic conditions are assessed by the average number of enterprises on the ground to evaluate the economic activity of the cluster. The ecological condition examines the influence of topography on the development of the cluster through the slope indicator. These factors were set as independent variables to detect their effects on the annual change in the amount of building land in a typical sample (dependent variable Y).

3.3 Reconstruction of village and township settlement system - construction of urban-rural integration evaluation system

Village and town settlement system restructuring and urban-rural integration evaluation are important links in understanding and promoting the process of urban-rural integration, and they involve assessing multiple dimensions affecting the mechanism of settlement transformation dynamics and the current state of urban-rural integration. The evaluation system consists of two parts: the evaluation of restructuring dynamics and the evaluation of urban-rural integration, aiming at comprehensively grasping the course of the restructuring of the village and town settlement system and the current state of urban-rural integration.

In the evaluation of reconfiguration dynamics, based on the analysis results of ten typical samples by geodetector method, six key factors are selected: distance from urban areas a1, distance from major roads a2, distance from highway off-ramps a3, population density a4, number of enterprises per land a5, and gradient a6, to construct a reconfiguration dynamics evaluation system of urban-rural integration, which is shown in Table1.

Table1. Urban-rural integration restructuring dynamics evaluation group West

norm	**(math.) factor**	**weights**	**unit (of measure)**	**Weighting assignment (0-100 points)**				
				100	80	60	40	20
location	Distance of urban areas	0.11	km	<5	[5,10)	[10,15)	[15,20)	＞

factor	from a1							20
	Road distance a2	0.02	km	<1	[1,2)	[2,3)	[3,4)	＞4
	Distance from highway off-ramp a3	0.21	km	<5	[5,10)	[10,15)	[15,20)	＞20
social factor	Population densitya4	0.33	Hundred persons/km^2	<10	(8,10]	(6,8]	(5,6]	<4
economic factor	Regional average number of enterprisesa5	0.30	pcs/km^2	＞20	(15,20]	(10,15]	(5,10]	<5
ecological factor	Slope a6	0.03	°	[0,5)	[5,10)	[10,15)	[15,25)	＞25

For the evaluation of urban-rural integration, the evaluation indicator system is constructed based on four dimensions: spatial, economic, social and demographic. Due to the limitation of data availability, the eight indicator subcategories finally selected are weighted by AHP hierarchical analysis to quantify the relative importance of each indicator in the evaluation of urban-rural integration. The weights of the indicators obtained are as follows: b1 Land urbanization level (0.060), b2 Transportation network density (0.208), b3 Share of non-agricultural industry (0.175), b4 Investment attractiveness (0.161), b5 Fiscal level (0.082), b6 Level of public budget (0.125), b7 Social consumption power (0.068), b8 Urbanization rate (0.122).

Finally, these evaluation indicators are assigned values according to a five-level scoring standard, with scores of 20, 40, 60, 80, and 100 in descending order, as shown in Table 2.Such a hierarchical assignment method aims to quantify the degree of spatial, economic, social, and demographic integration of village and town agglomeration systems, and to provide a scientific basis for further analysis, evaluation, and decision-making. This comprehensive evaluation framework not only helps to identify the current state of urban-rural integration and existing problems, but also provides an important reference for formulating corresponding optimization and adjustment strategies and measures.

Table2. Assignment table for evaluation of urban-rural integration of village settlements

norm	**(math.) factor**	**weights**	**Description of indicators**	**Weighting assignment (0-100 points)**				
				Level 1	Level 2	Level 3	Level 4	Level 5
spatial	Land urbanizationb1	0.060	Built-up space area/land area (%)	20	40	60	80	100
	Transportation network densityb2	0.208	Road mileage/land area (km/km^2)	20	40	60	80	100
economics	Non-farm industry ratiob3	0.175	Share of non-agricultural GDP (%)	20	40	60	80	100
	Investment attractivenessb4	0.161	Fixed investment per capita (million yuan)	20	40	60	80	100
societies	Financial levelb5	0.082	Per capita fiscal revenue (10,000 yuan)	20	40	60	80	100
	Public budgetb6	0.125	General public budget per capita (million yuan)	20	40	60	80	100
	Social spending powerb7	0.068	Retail sales of social consumer goods per capita (10,000 yuan)	20	40	60	80	100
demographic	Urbanization rateb8	0.122	Urban population/total population (%)	20	40	60	80	100

3.4 Types of reconfiguration of the village settlement system

In the study on the reconstruction of the village and township settlement system and the evaluation of urban-rural integration, the matrix discriminant method reveals that the development of villages and townships can be categorized into four typical modes: agglomeration and enhancement (high potential and high integration), strengthening of public services (low potential and high integration), complementary development (high potential and low integration), and intensive utilization (low potential and low integration), through the comprehensive

consideration of the results of the evaluation of the reconstruction dynamics and the degree of integration. This classification not only accurately reflects the current situation and potential of village and township settlements in the process of urban-rural integration, but also provides a theoretical basis for further strategy development.

As an extension of the economic development of urban areas, agglomeration-enhancing villages and towns are characterized by a high concentration of population and industry and a well-developed transportation network, indicating their key role in the process of urban-rural integration. For such villages and towns, the strategy should focus on the in-depth integration of resource integration and urban development, promote the joint progress of industrial upgrading and urban infrastructure, and promote the further enhancement of the agglomeration effect through the pulling effect of urban areas.

Despite their spatial proximity to the urban areas, villages and towns of the enhanced public services type have a relatively weak development potential and find it difficult to take on large-scale industrial development tasks on their own. Therefore, the construction of infrastructure and public service facilities should be strengthened for these types of villages and towns, so as to enhance their functions as urban satellite towns or residential areas, and to attract the population of urban areas to disperse to the surrounding areas, so as to alleviate the pressure on urban areas.

Complementary development villages and towns have a good foundation for their own development, but are not yet closely linked to urban areas. Strategies should focus on tapping and integrating the industrial advantages of these villages and towns and developing characteristic industries, while strengthening differentiated development with urban areas and promoting economic complementarity within the region, so that they can become new poles for regional growth.

Challenges faced by intensively utilized villages and towns include long distances from urban areas, unfavourable topographical conditions and fragile ecological environments, which have led to their limited development potential. For such villages and towns, the relocation and de-merger of settlements, intensive land use and the development of special industries can effectively integrate resources, create scale advantages and achieve complementary integration with urban areas, which is a feasible way to optimize their development patterns.

4. CASES OF RECONSTRUCTION OF VILLAGE AND TOWN SETTLEMENT SYSTEM IN THE CONTEXT OF URBAN-RURAL INTEGRATION AND TRANSFORMATION

4.1 Introduction to cases

4.1.1 Yinzhou District Overview

As the core of the economic development of Ningbo and the entire Yangtze River Delta region, Yinzhou District has long been an important symbol of the city's and even the region's economic strength. In the assessment of the country's comprehensive strength, Yinzhou District is constantly at the forefront, demonstrating its position as a key economic component of Ningbo. In order to respond to the strategic needs of urban development and to promote a faster process of urbanization, the Ningbo Municipal Government has incorporated a number of streets from the former Jiangdong District into the administration of Yinzhou District. With its remarkable development in manufacturing, retailing and import/export trade, Yinzhou District has strengthened its position as a bright spot area for economic development in the country. In addition, the region has excelled in the process of urban-rural integration and is in a leading position nationwide. The economic development of Yinzhou District, there are several important time nodes worth paying attention to. 2002 April 19, approved by the State Council, Yinzhou District from the "withdrawal of the county to set up districts" was formally established. 2016 September 14, in order to cooperate with the city's strategy of expanding to the east, in accordance with the "one of the three reforms

"The development goal, the former Jiangdong District part of the administrative area into Yinzhou District. Meanwhile, part of the area formerly belonging to Yinzhou District was assigned to Haishu District for administration.In December 2018, Meihui Street was further subdivided and Juxian Street was added, a change reflecting the local government's continued efforts to optimize administration and promote urban-rural integration. Through the implementation of these administrative division adjustments and development strategies, the urban and rural structure of Yinzhou District has undergone significant changes, especially in terms of urban-rural integration and development, and its experience is representative of the country as a whole. In addition, Yinzhou District has been continuously awarded national honors in many aspects such as economic strength, investment potential and green development, which fully demonstrates its important position as the economic highland of Ningbo City and even the Yangtze River Delta region.

4.1.2 Data processing

In the study exploring the change of village and town settlement system in Yinzhou District, Ningbo City, the information used is mainly categorized into two main types: spatial data and socio-economic statistics. The spatial data are mainly generated by analyzing the land use maps generated from the 30m*30m resolution image maps of 2010, 2014, 2018 and 2022, which are obtained by decoding using ENVI software. The socio-economic statistics, on the other hand, involve various types of digital information related to regional development.

Several challenges in the use of data were identified in the study: the first is the incompleteness of statistical information. Particularly at the commune level, the data focuses more on the agricultural sector, while there is a lack of information on industry, public service facilities, and socio-cultural and educational resources. This bias limits the range of indicators that can be used in assessing changes in the village and township settlement system and in constructing an evaluation system, which may lead to one-sided analysis results. Therefore, the study needs to draw on other methods and data sources to gain a more comprehensive understanding. Secondly, the inconsistency of spatial data in terms of scale and precision is also a problem. As the spatial data required for the study were mainly obtained through internet downloads, this resulted in differences in precision and scale, and appropriate adjustments to the spatial data were needed to ensure consistency. Further, the adjustment of administrative divisions also affected the study. Especially after the administrative division adjustment in 2016, the data of some townships needed to be queried from the statistical yearbook of Haishu District, which posed a challenge to the continuity and consistency of the data. Finally, the harmonization of administrative units and the determination of research subjects are also issues to be considered in the study. Due to the administrative division adjustments in 2002 and 2016, it makes it difficult to correspond the statistics of some townships on the same spatial scale. Therefore, this study is based on the current administrative division and adopts methods such as spatial data backpropagation to ensure the correspondence between spatial data and statistical data. At the same time, in view of the good economic development and high degree of urban-rural integration of the streets in the central city of Yinzhou District, it was decided not to include them in the scope of this study on the optimization of village and township settlement monoliths.

4.2 Evaluation results

4.2.1 Evaluation process and factor overlay analysis

In the evaluation study of urban-rural integration and reconstruction dynamics in Yinzhou District, Ningbo City, based on the evaluation system constructed in Chapter 4, six main influencing factors, including location factors, social factors, economic factors, and ecological factors, were comprehensively analyzed. First, six specific factors, namely, urban area distance, major road distance, highway off-ramp distance, population density, land-per-capita enterprise, and slope, were evaluated by factor analysis. The distance to the urban area was determined according

to the urban development boundary defined in the Ningbo City Master Plan; the distance to major roads and the distance to high-speed off-ramps were comprehensively evaluated by analyzing Google satellite images and related data; the population density factor was assigned values based on the population density of each township; the per capita enterprise factor was scored based on the density of the enterprises; and the slope factor was assigned values based on the graded terrain slope. Finally, based on the weight of each factor, factor superposition is carried out to form the comprehensive evaluation results of urban-rural integration and reconstruction dynamics, which provides a scientific basis for the urban-rural integration and development of Yinzhou District.

Through the analysis of the data of townships in Yinzhou District, eight factors such as the level of land urbanization and the density of transportation network are divided into five levels according to their value ranges, and assigned the values of 20, 40, 60, 80, and 100, respectively. , per capita total fiscal revenue, per capita general public budget, per capita retail sales of consumer goods, and urbanization rate as key indicators representing the degree of urban-rural integration (see Table3).

Table3. Data related to the evaluation of urban-rural integration in Yinzhou District

administrative area	land area	GDP	Percentage of construction space	Average road mileage	Percentage of non-agricultural industries	Fixed investment per capita	Gross fiscal revenue per capita	General public budget per capita	Retail sales of consumer goods per capita	urbanization rate
Junqi Township	82.8	16.38	23.88%	0.29	84.34%	0.50	1.25	0.60	0.02	40.15%
Xianxiang township, Shaanxi	57.6	17.63	17.14%	0.23	80.12%	0.71	1.29	0.65	0.10	45.64%
Tongxi township, Hainan	78.8	19.30	12.42%	0.28	94.04%	0.96	0.94	0.51	1.05	25.24%
Dongqianhu township, Hainan	129	73.37	16.74%	0.34	96.05%	17.25	4.48	3.19	0.25	48.25%
Dongwu town (common place name)	71.5	32.49	16.04%	0.48	95.75%	7.79	3.36	1.78	0.68	46.59%
five townships	47.4	62.77	46.29%	0.49	95.87%	4.99	2.88	1.62	0.42	75.54%
Qiuai township, Hainan	23.4	46.46	76.32%	0.60	94.37%	13.64	3.49	2.08	0.29	77.79%
Yunlong township, Hainan	32.1	51.85	40.19%	0.58	97.23%	6.61	3.04	1.65	2.08	29.41%
Hengxi township, Hainan	84.3	28.12	12.63%	0.47	95.17%	1.42	1.42	0.79	0.46	32.30%
Jiangshan town (common place name)	87.8	114.4	37.71%	0.59	94.75%	5.38	2.96	1.58	0.82	38.47%

Since Xinming Street, Juxian Street and Meixi Street are entrusted to the management committee of Ningbo National Hi-tech Industrial Development Zone, the relevant data are temporarily missing, even though they still belong to Yinzhou District in terms of administrative division. Based on the economic and social geographic data

of each township agglomeration monolith in 2018, the factors of integration of townships in Yinzhou District are scored by expert scoring method, including eight factors under the four dimensions of spatial integration, economic integration, social integration and demographic integration, such as the level of urbanization of land, density of the transportation network, the percentage of non-agricultural industries, fixed investment, financial income, general public budget, social consumption power, urbanization rate and so on. Specific indicators. In the case of urban streets, the default score for each factor is 100 in view of their favorable development (see Table4).

Table4. Scoring table for the evaluation of urban-rural integration in Yinzhou District

Evaluation of urban-rural integration	Level of land urbanization	Transportation network density	Percentage of non-agricultural industries	fixed investment	revenue	General public budget	social spending power	urbanization rate	total score
weights	0.06	0.208	0.175	0.160	0.083	0.120	0.073	0.121	1.000
city district	100	100	100	100	100	100	100	100	100
Junqi Township	40	40	40	20	40	20	20	40	32.94
Xianxiang township, Shaanxi	20	40	40	20	40	20	20	40	31.74
Tongxi township, Hainan	20	40	60	20	20	20	40	40	35.04
Dongqianhu township, Hainan	20	60	80	80	100	80	20	40	64.68
Dongwu town (common place name)	20	60	80	40	80	40	20	40	51.82
five townships	60	60	80	20	60	40	20	80	54.20
Qiuai township, Hainan	80	80	60	60	80	60	20	80	66.52
Yunlong township, Hainan	60	60	80	40	80	40	60	40	57.14
Hengxi township, Hainan	20	60	80	20	40	20	20	40	42.90
Jiangshan town (common place name)	40	60	40	60	40	20	40	40	44.96

4.2.2 Type matrix discrimination of evaluation results

After evaluating the reconfiguration of villages and townships and their urban-rural integration in Yinzhou District, the results show that the ratings of urban-rural integration are, in descending order, urban area, Qiuai Town, Yunlong Town, Jiangshan Town, Wuxiang Town, Xianxiang Town, Tangxi Town, Dongqianhu Town, Dongwu Town, Hengxi Town, and Zhanqi Town. Meanwhile, the order of scores of urban-rural integration and reconstruction dynamics is urban area, Qiuai Town, Dongqianhu Town, Yunlong Town, Wuxiang Town, Dongwu

Town, Jiangshan Town, Hengxi Town, Tangxi Town, Junqi Town, and Xianxiang Town (see Table 5). Based on the results of these two sets of scores, the optimization types of village and town cluster monoliths were classified by the method of double evaluation type matrix (see Table 6).

Table 7 shows the categorization results of the townships in Yinzhou District. This categorization not only reflects the current status of the villages and townships in the process of urban-rural integration, but also points out their possible directions of development in the future reconfiguration of urban-rural integration. Urban areas are naturally at the top of the evaluation system due to their high degree of urbanization and integration dynamics. Qiuai Township, Yunlong Township and Jiangshan Township show strong potential for integration and development prospects due to their high degree of urban-rural integration and reconfiguration dynamics. For the lower rated townships, such as Junqi Township and Xianxiang Township, it is implied that more work needs to be done to improve the degree of urban-rural integration and to stimulate the reconfiguration dynamics of integration. Through this dual evaluation type matrix division, the specific position and challenges faced by each village and town in the process of urban-rural integration can be identified more systematically, providing a basis for the development of targeted optimization strategies and measures, thus promoting the overall urban-rural integration and sustainable development of Yinzhou District.

Table5. Evaluation results of reconfiguration and integration of village and town settlements in Yinzhou District

Evaluation of the dynamics of reconfiguration of urban-rural integration	score	95.67	90.30	88.73	75.20	51.76	49.60	48.38	44.49	41.98	31.70
	townships	Yau Wai	muscovite, mica (used in TCM)	Jiang Shan	the five boroughs of New Zealand	reign name of Qing emperor (1871-1941)	pond	Dongqian Lake	Eastern Wu (222-280)	Yokohama Stream	divergent
Evaluation of urban-rural integration	score	66.70	64.96	57.01	54.26	51.88	47.94	42.88	34.94	32.92	31.72
	townships	Yau Wai	Dongqian Lake	muscovite, mica (used in TCM)	the five boroughs of New York City	Eastern Wu (222-280)	Jiang Shan	Yokohama Stream	pond	divergent	reign name of Qing emperor (1871-1941)

Table6. Matrix discriminations for village and town cluster reconstruction-urban-rural integration evaluation

Potential-integration evaluation		**Urban-rural integration**	
		Low fusion (0-50)	High integration (50-100)
Urban-rural integration reconfigures dynamics	Low potential (0-50)	Type A (High Potential High Integration)	Type C (high potential low integration type)
	High potential (50-100)	Type B (low potential high integration type)	Type D (low potential low integration type)

Table7. Optimization Types of Townships in Yinzhou District

rating	**Type of evaluation**	**townships**
Category A	Clustering and upgrading	Qiuai Township; Yunlong Township; Wuxiang Township
Category B	Enhanced public service type	Jiangshan Town; Xianxiang Town

Category C	Complementary development	Dongwu Town; Dongqianhu Town
Category D	Intensive utilization	Tangxi Township; Hengxi Township; Junqi Township

4.3 Optimization Strategies

4.3.1 Multipolar centers, regionally driven

By evaluating the status quo of urban-rural integration in Yinzhou District, it can be observed that the village and township settlement system in the region has already achieved a certain development foundation under the agglomeration effect of the urban area and Ningbo city center. Facing the limitations of environmental capacity and economic benefits, some industrial functions began to spread to the lower townships such as Dongqianhu Township, Jiangshan Township, Xianxiang Township, etc., which prompted the rapid development of these areas and the gradual formation of one or more sub-centers, which in turn formed the hinterland of villages and townships with a driving effect, and pushed forward the development of the corresponding regions. The village and town cluster system in Yinzhou District is of the industrial complementary integration type, and it is suitable to adopt the optimization mode of "core - hinterland", which focuses on considering the driving effect of the sub-centers and central towns on the hinterland of the region, as well as the complementary and synergistic development with the functions of the urban area.

In order to promote the synergistic development of urban areas and central towns, it is necessary to objectively assess the development differences between townships and promote the synergistic and complementary functional structure based on compact spatial form, and cultivate the village and township development core of "one main and one secondary center". While consolidating the position of Yinzhou city center, accelerate the development of sub-centers, especially based on the "Ningbo City Master Plan" will be the development of Dongqianhu Town as the periphery of the Ningbo city group, to promote Dongqianhu Town to become the sub-center of Yinzhou District. In addition, to promote the center and sub-centers, the city and the surrounding villages and towns in the transportation, information network and industrial division of labor, to encourage various forms of regional cooperation [19-21].

To further optimize the urban-rural integration system, increase the residential and economic density of cities, establish a safe, comfortable and efficient street network and strengthen the social integration of communities. At the same time, it will strengthen the construction of green infrastructure, support the preservation and layout of urban open space and enhance the sustainable development capacity of cities. Through these measures, the development pattern of village and town settlement system of "one main and one time, three axes and two circles" will be formed, with Yinzhou urban area as the core of the network, Dongqianhu Town as the sub-center of the urban expansion, Jiangshan Town, Xianxiang Town and Wuxiang Town as the center towns, and relying on the Yongguan Axis to link the north-south town network, which will drive the development of first- and second-tier town development circles together. Development.

Finally, according to the development status and potential of the townships in Yinzhou District, the township quality of the central townships will be further upgraded to accelerate the promotion of the connection between the urban areas and the central townships in terms of transportation, information network and other aspects as well as the division of labor and collaboration of industries. This not only promotes the east-west balanced layout of the urban-rural composite network nodes, but also provides the rural population with opportunities for employment and residence in the vicinity, forming a differentiated and complementary industrial and township pattern.

4.3.2 Efficient networks, balanced facilities

By establishing an efficient transportation network, Yinzhou District can advocate a transportation-oriented urban-rural composite spatial network structure, which in turn creates a comprehensive transportation hub and constructs external linkages. Such a layout not only improves the rapid transportation network between urban and rural areas,

meets the spatial development needs of multi-center and network, but also accelerates the rapid connection between urban areas and key towns, and significantly improves the efficiency of factor circulation [22-23]. In addition, increasing the efforts to improve the quality of urban and rural roads will help realize the seamless connection of urban and rural transportation networks, increasing the accessibility of village and town areas to urban areas. By vigorously promoting the construction of village and town public transportation system and realizing the full coverage of urban and rural public transportation as soon as possible, it not only improves the travel convenience of village and town residents, but also advocates the transportation-oriented urban and rural spatial organization model [24-26]. In the village area, the village highway layout can be relied upon to adopt the spatial structure optimization mode of village settlement with perfect function and moderate scale, i.e., the rural highway-oriented development mode, to form the village settlement system with orderly grades, reasonable layout and interconnectedness, and then to improve the intensive utilization of village land.

The implementation of a demand-oriented allocation of public services in urban and rural areas is a key measure to promote the equalization of public services in urban and rural areas. The gap in public services between urban and rural areas can be effectively narrowed by focusing public service facilities in urban areas on the extension of strengthened public service-type townships, such as Jiangshan Township and Xianxiang Township, and by making up for the relevant facilities in areas lagging behind in terms of public service facilities, such as Hengxi Township and Tangxi Township. Taking the resident population as the basic basis for the allocation of public services, the capacity of public services in village and township areas has been substantially increased, and the establishment of a public service system for population mobility has been accelerated to promote the transfer of laborers between urban and rural areas and across regions for employment, as well as the strengthening of compulsory education, vocational education and vocational skills training. In addition, safeguarding the rights of vulnerable groups to enjoy basic public services, ensuring that rural migrant workers and their accompanying children have fair access to basic education and public health care in urban areas, and increasing the level of medical assistance and educational funding for poor families are important links in the process of realizing urban-rural equalization of public services.

4.3.3 Urban-rural transition and complementary functions

For general towns on the far outskirts of urban areas, such as Tangxi Town and its surrounding villages, the intensive utilization type of development mode should be fully utilized. Combined with the policy of precise poverty alleviation, there is a need to increase investment in infrastructure and basic public services, as well as to strengthen the protection of the characteristics of villages and towns and the creation of vitality, so as to ensure the sustainable livelihood of farmers [27-29]. Advocating the establishment of village and town alliances, encouraging the formation of alliances between villages and towns that are geographically close or have some kind of connection, jointly developing industries to improve risk resistance, promoting learning and exchanges among members of the alliance, fostering the independent innovation ability of farmers, and promoting the dissemination of knowledge and technology.

With regard to the optimization of the layout of villages in village areas, it is first necessary to analyse the problems that exist in the current situation, such as the contradiction between the implementation of urban planning and the townscape, the serious situation of environmental protection in the villages, and the weakness of the central village's agglomeration capacity. In the optimization process, the planning of individual villages should be considered in a comprehensive manner with the needs of coordinated development of the region as a whole, not only to meet the needs of agricultural development, but also to take into account the tendency of the population and industries to

cluster in towns. At the same time, the optimization plan should be linked to existing plans and take into account the construction of central villages and the adjustment of administrative villages.

For areas with low development potential and remote locations, the strategy of withdrawing villages and merging points is implemented to complete a rational layout according to the three-level scale standards of central villages, general villages, and natural villages. This method not only optimizes the spatial layout of villages, but also helps to improve the intensive use of land and promote the healthy development of village and township economies, while safeguarding the quality of life and livelihood security of farmers [30]. Through these measures, the ecological environment of villages and towns can be effectively upgraded to provide urban residents with high-quality ecological leisure experience places, while promoting the harmonious development of urban and rural areas.

4.3.4 Ecological protection, synergistic governance

Coordinated development of all types of land resources, controlling the total amount of construction land and increasing ecological space on the basis of protecting the ecological environment and controlling the scale is a key strategy for realizing intensive land use. Through the implementation of differentiated land-use policies, it is possible to guide urban construction land towards vertical space, i.e., the development of aboveground and underground space, in order to expand new construction land space. At the same time, comprehensively promoting the comprehensive improvement of mountains, water, forests, fields, lakes, seascapes and grasses in villages and their surroundings, and orderly promoting the centralized layout of rural settlements aim to improve the production and living conditions of peasants, optimize the land-use structure, enhance the production capacity of land, and protect the idyllic landscapes of villages and towns [31].

Strictly observing the control line of permanent basic farmland and integrating basic farmland protection with ecological protection are important measures to ensure food security and ecological balance. At the same time, it protects important ecological function zones and enhances the service function of ecosystems by protecting and upgrading the function of ecological space and promoting the integration of ecological services, tourism services and agricultural services. The rational layout of green space in cities and towns and the strengthening of eco-cities and eco-towns are of great significance in enhancing the quality of life of urban and rural residents and promoting sustainable development. In order to jointly promote the balanced development of the urban-rural complex network system, it is necessary to improve the coordination system, set up multilevel coordinating bodies and various non-governmental coordinating organizations, and break down institutional barriers. These institutions will be responsible for coordinating the cooperation between the urban-rural composite network and neighboring regions, the cooperation between internal development zones and key towns, as well as the implementation plan and supervision of major regional public projects, and will be committed to the establishment of an effective cooperation mechanism with shared benefits and inputs [32].

Through the preparation of flexible and sustainable spatial planning for the town system, strengthening the control of urban spatial growth, guiding the development of villages and towns, and protecting ecological open space, it is possible to effectively protect and rationally utilize the area where the urban area meets the sub-centre and the central town, and to protect the agricultural development area. At the same time, the water quality of the neighboring sea area will be comprehensively remedied, and a lake and sea ecological corridor with benign ecological cycle and beautiful landscape environment will be constructed, so as to provide urban and rural residents with a healthier and more beautiful living environment.

5. CONCLUSION

In the context of urban-rural integration and transformation, this study reveals the impact of key factors such as economic development, policy support, and geographic location on the evolution of settlements through an in-depth

discussion of the reconstruction of the village and town settlement system, and proposes targeted optimization strategies. However, there are some shortcomings in the study, such as limitations in data collection and restrictions on the scope of model application, which may have affected the generalizability and depth of the findings. Future research should focus on expanding the data sources and improving the generalizability of the model, as well as deepening the consideration of socio-cultural factors in urban-rural integration, in order to understand and promote the process of urban-rural integration more comprehensively. In addition, further research needs to explore the application of new technologies in promoting urban-rural integration and development, as well as how policies can be effectively implemented to promote sustainable settlement system optimization and socio-economic development.

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