Coordinated Delineation of “Three Districts and Three Lines”: Anatomy of the Phenomenon, Technical Logic and Nanjing's Experience

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Abstract: To align with the territorial spatial planning reform, facilitate multiple plan integration, enhance the authority of spatial plans, and achieve the goal of high quality development, it becomes imperative to coordinate the demarcation of three control lines on territorial spatial master plans, promote the modernization of spatial governance, and enhance governance capacity. In various localities, lack of under- standing of overarching policy documents has resulted in poor coordination of three control lines. For example, the mechanical implementation of farmland protection mandates has led to the fragmentation of cultivated land, the inability to adjust eco-logical red lines gives has caused management difficulties, and the inappropriate drawing of urban growth boundary has resulted in questionable urban size, form, and layout. To solve these problems, the paper proposes to establish a scientific methodology for delineating three zones and three lines. The core rationale is to en-sure coordination among the three lines and various elements of territorial spatial master plans. In addition, the paper introduces exemplary practices in Nanjing, em-phasizing its scientific delineation of three control lines, adherence to ecological and systematic views, optimization of spatial structure, and a scientific projection of ur-ban scale. These practices serve as a practical reference for spatial optimization in territorial spatial planning.

Keywords: "three zones and three lines"; territorial spatial master plan; overall coor-dination; technical rationale

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Since the 18th CPC National Congress, the Central Government has called for the construction of a national spatial planning system, the promotion of “multi-planning”, the scientific delineation of the “three zones and three lines”, the establishment of a national spatial planning system and the supervision of its implementation, and the comprehensive delineation and implementation of the three lines of control in national spatial planning. The Twentieth National Congress of the CPC further proposed the modernization of the national governance system and governance capacity. At present, the “three zones and three lines” of the country have been approved, and have become an important part of the preparation of land spatial planning and a rigid basis for implementation in the new era, and the “three zones and three lines” have become an important part of the land spatial governance system. Given that the delineation of the “three zones and three lines” is an innovative work that inherits all kinds of control policies, technical standards and related planning from history, the industry and regions have been concerned about how to implement “scientific delineation” and “integrated delineation” in the delineation. There are different understandings and practices in the industry and in various regions regarding how to implement “scientific delineation” and “integrated delineation” in the delineation of the “three zones and three lines”. Based on the analysis of the phenomena in the delineation of the “three lines”, this paper further clarifies the technical routes for the formation of the “three lines”, with a view to implementing the “three lines” in a high-quality manner, regulating the “three lines” in a standardized and orderly manner, and forming the systematic design for the optimal layout of urban and rural space.

1 Background of the study

1.1 The status and role of “three zones and three lines

General Secretary Xi Jinping pointed out that it is necessary to adhere to the bottom line thinking, based on the national land spatial planning, and take the red line for urban, agricultural and ecological space and ecological protection, permanent basic farmland, and the urban development boundary as the insurmountable red line for adjusting the economic structure, planning the development of industries, and advancing urbanization. Territorial spatial planning is the top-level design for building the development and protection pattern, and the comprehensive delineation of the “three zones and three lines” in territorial spatial planning is the basis for reflecting the bottom-line thinking, re-establishing the order of the “whole area and all elements”, and optimizing the territorial spatial pattern[1] . Relevant national policy documents and domestic and international research practices have shown that “three zones and three lines” is the foundation for the sustainable development of the Chinese nation, and is an important tool for realizing the rigid control of national spatial space, and has an important role and significance in the new type of national spatial planning system. Since the reform of the national spatial planning system, the “three zones and three lines”, as an important means of optimizing the spatial layout of the national territory and implementing the use control of the national territory, have been an important part of the preparation and supervision of the implementation of the national spatial planning at all levels[2] . Among them, the permanent basic farmland and the red line of ecological protection determine the bottom line for the

protection of national land resources, and the urban development boundary determines the upper limit of national land development.

1.2 Top-level design of the delineation of "three zones and three lines

After the reform of national institutions, the newly formed Ministry of Natural Resources (MNR) has assumed the responsibilities of "multi-planning", establishing a spatial planning system and supervising its implementation, and the management responsibilities for the delineation of the three control lines, which were originally dispersed among the relevant departments, are unified by the MNR.In May 2019, the Central Committee of the Communist Party of China (CPC) and the State Council issued the "Opinions on Establishing a Spatial Planning System and Supervising Its Implementation". System and Supervise Its Implementation, which provides institutional safeguards for the integrated delineation and implementation of the three control lines.In November 2019, the General Office of the CPC Central Committee and the General Office of the State Council jointly issued the Guiding Opinions on the Integrated Delineation and Implementation of the Three Control Lines in Territorial Spatial Planning (hereinafter referred to as the "Three-Line Guiding Opinions"), which further clarifies the basic principles, specific requirements and control rules for the delineation of the three lines, and It further clarifies the basic principles, specific requirements and control rules for the delineation of the three lines, and provides a policy basis for the integrated delineation of the three control lines nationwide. Subsequently, the Ministry of Natural Resources promptly issued a series of delineation procedures, technical specifications and other documents on the "three zones and three lines". These documents have played an exploratory and good guiding role in the preparation of land spatial planning and the scientific delineation of the three lines across the country. By now, the top-level design of the "three lines" policy has been basically completed, and the key points of the system have been gradually clarified.

1.3 Core issues of "three zones and three lines" delineation

In the process of practice, there are some deviations in the understanding of the guiding documents on the priority order and interrelationship of arable land and permanent basic farmland, ecological protection red line, urban development boundary, as well as the implementation of the rules for the delineation of individual lines, which more or less shows the phenomenon of isolation delineation. The core problems encountered in the implementation of integrated demarcation are as follows: firstly, the three lines are not sufficiently linked with the spatial planning of the land. The delineation of the three lines is not a numbers game, but a process of implementing strategic intent, guarding the bottom line, reflecting priorities, optimizing the spatial layout of the national territory, and promoting the economical and intensive use of resources[3] . Since the results of the three-line delineation were first reported and approved for implementation during the preparation of the spatial master plan, some regions mistakenly thought that the three-line delineation was an independent stage. Other important contents of the spatial master plan, such as urban scale prediction, urban spatial structure and morphology, comprehensive urban transportation planning, historical and cultural preservation, and the shaping of urban characteristics, seem to have been completed separately after the delineation of the three lines. Secondly, the relationship between the three lines is relatively isolated. Some scholars have realized that there should be some internal connection and delineation logic among the three lines in their research[4] , but in the practice of some regions, the rules of single line delineation are simply implemented, and there is a lack of

integrated consideration of the three control lines, which makes the coordination among the three lines difficult[5-6] . Third, the spatial form of the three lines is not systematic enough. The delineation of “three lines” is mostly based on the reasonableness of specific maps, and often lacks the overall consideration of spatial pattern and system structure[7] . Since the “Three Lines” Guidance Opinions have clarified the allocation principles of relevant arable land reserve at all levels, the scale requirements such as urban expansion coefficients, etc.

Since the Three-Line Guidance Opinions have specified the principle of allocation of relevant arable land reserve at various levels, urban expansion coefficients and other scale requirements, localities have tried their best to implement the scale tasks, but the spatial landings (i.e., the spatial patterns formed by the various types of control lines) are relatively rough.

2 Analysis of phenomena in the delineation of the three lines

2.1 Analysis of the phenomenon of demarcation of arable land and permanent basic farmland

2.1.1 Emphasizing the inheritance of the original plan, but insufficient consideration of the relative imperfection of the original plan

The delineation documents require that, in principle, only the arable land located within the scope of construction land that is consistent with the original “Land Master Plan” and “City Master Plan” can be excluded from the permanent basic farmland. If the new version of the spatial master plan needs to be adjusted to plan the shape of the construction land, where the original permanent farmland is involved, not in line with the original two rules, there is a lack of layout optimization path. In addition, the original permanent basic farmland, and “three adjustments” for the status quo arable land, in principle, must be designated as permanent basic farmland. Where there is a contradiction with the major strategies of urban development, there is a lack of layout optimization paths. See Figure 1 and Figure 2.

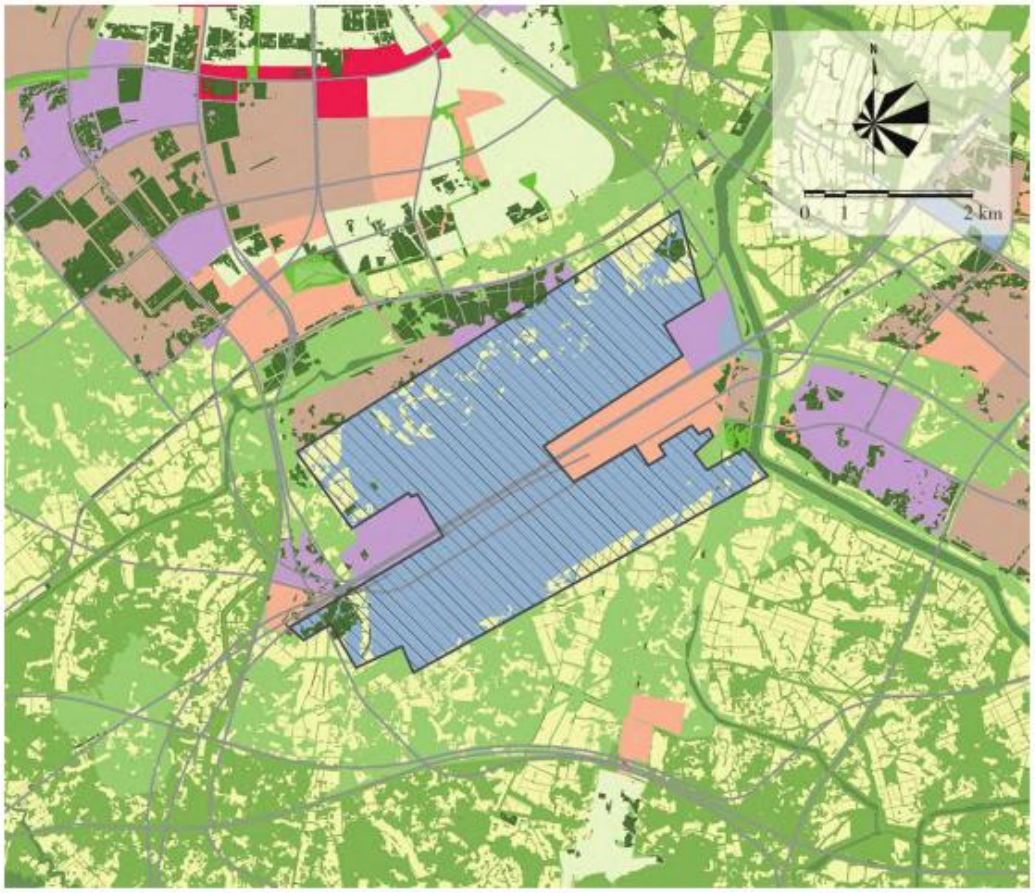

Fig.1 Relationship between planned airport expansion and designated permanent basic farmland

Fig.2 Relationship between a proposed high-speed train station on the North Bank of Yangtze River and designated permanent basic farmland

2.1.2 Cross-distribution of existing urban construction land and existing scattered farmland

Under the premise of the priority order of arable land protection, if the status quo land category is arable land, the nature of the land cannot be changed. In some areas, due to historical reasons, there are some scattered cultivated land interspersed with construction land (Fig. 3), and there is no path for optimization and adjustment. As a result, both types of land are fragmented, which can neither realize the high level protection of arable land nor affect the high quality development of urban space.

Fig.3 Fragmentation of cultivated land

2.1.3 Transmission of the proportion of tasks at each level, without differentiated allocation according to the actual development and the effectiveness of permanent farmland protection.

Taking a city in the east as an example, due to the overall topography, natural geographic pattern, population and economic distribution and development trend, the water resources are less binding, and the development of land space shows obvious characteristics of multiple suitability. The land suitable for farming is also an important area for ecological protection and a suitable area for urban construction. The conclusion of the dual evaluation is the bottom line of each line, revealing the basis of “drawable” space. On this basis, the three types of space should be comprehensively coordinated to reach the conclusion of “should be delineated”. In addition, as a political, economic, military and cultural town, a certain city, under the premise that the total space is limited and Yongnong delineation is the first priority, in order to implement the provincial allocation of 90% of the protection and delineation tasks, “should be delineated” becomes “can be delineated”.

2.1.4 The caliber of current cultivated land, replacing cultivation potential with cultivation type

Under the principle of “what you see is what you get” of agricultural structural adjustment and “three adjustments”, the rules for recognizing arable land have changed. In the “second survey”, land temporarily planted with fruit trees, tea trees, forest trees, medicinal herbs, turf, flowers, and fish, shrimp, crab, etc. on arable land with undamaged cultivation layer was surveyed as arable land. In the “Three Surveys”, forest land, grassland, water surface of pits and ponds, etc. are surveyed as non-cultivated land according to the current situation on the ground. These lead to a reduction in the base of arable land that can be categorized as permanent farmland, and there are difficulties in delineating permanent basic farmland according to scale.

2.1.5 Uncertainty about the path of “i.e. restorable” and “engineering restorable” arable land as a reserve resource

Due to the in-depth implementation of the new rural construction and rural revitalization strategy, the grassroots have spontaneously adjusted the agricultural structure and implemented a variety of operations in the agricultural economy. The most typical ones are shrimp and crab ponds and nurseries for shallow-water aquaculture, which are mostly recognized as “restorable” land by the “three adjustments”, but the cultivation layer has not changed substantially, and they are still high-quality arable land resources. The “recoverable” land is recognized as arable

land in the “second adjustment”, based on which the target scale of arable land protection is set, but it is recognized as non-cultivated land in the “third adjustment”, and cannot be classified as permanent agriculture. Take a city in the east as an example, i.e. more than 100 square kilometers of agricultural land can be restored for rice and crab farming, which could have supplemented the shortfall of the arable land protection target, but under the current rules, the “restorable” land category is included in the shortfall in terms of scale, leading to mismatches in the localities in completing the permanent basic farmland protection target.

2.1.6 Summary of the delineation of arable land and permanent basic farmland

The systematic nature of spatial planning is crucial to its scientific expression, and no single element should be overemphasized to the neglect of other elements[8] . The implementation of the scale of permanent basic farmland should be the first priority order in all kinds of spatial allocation. In the process of demarcation, safety and development should be considered in an integrated manner, and on the basis of the implementation of the scale, the spatial landing should be carried out in accordance with the principles of optimization of the layout of land for urban construction and articulation between ecological spaces. It cannot simply prioritize the demarcation line based on the original land planning and whether the current situation is arable land or not. Otherwise, the spatial mismatch brought about by the fragmentation of the distribution of arable land and the fragmentation of construction land is inconsistent with the goal of land spatial planning reform and the goal of high-quality development.

At the same time, if the current scale of arable land protection on the basis of the implementation of 90% of the permanent basic farmland delineation task can not be completed, there should be “relief” measures. At present, Jiangsu has a basic farmland “easy to protect” system: it is recommended that the implementation of easy to protect the system at the same time, the establishment of arable land reserve area system, in the arable land occupation “account for one to make up for one” “increase and decrease hook” system, under the protection of the system, the basic farmland should be protected by the “relief” measures. Under the guarantee of the “one for one, one for all” system for the occupation of arable land, it is proposed that the task of delineating basic farmland be realized by “exchanging time for space”.

2.2 Analysis of the phenomenon of ecological protection red line demarcation

2.2.1 “Inheritance” delimitation leads to the red line of ecological protection being “difficult to adjust even though it is assessed”.

The General Office of the CPC Central Committee and the General Office of the State Council issued the “Guiding Opinions on the Establishment of a Nature Reserve System with National Parks as the Main Body”, which requires the establishment of a nature reserve system with national parks as the main body, and the formation of a classification system of nature reserves with national parks as the main body, nature reserves as the basis, and various types of nature parks as a supplementary nature reserve system; the “Three Lines of Guiding Opinions” requires that nature reserves be adjusted and optimized, and that the assessment of the red line should be made. The adjusted nature reserves should be assigned to the ecological protection red line. However, the actual situation of the delineation work is that different types of nature reserves such as national parks, nature reserves, forest parks, scenic spots and other types of protected areas under the jurisdiction of various departments are basically integrated according to the “list” of the directory, and together they constitute the ecological protection red line. The

adjustment and optimization of the original nature reserve area and the refinement and calibration of the boundary are restricted by the original management and approval department, and it is difficult to obtain recognition, resulting in the area to be designated as the ecological protection red line being “difficult to adjust despite assessment”. The “difficult to adjust despite assessment” is also manifested in the so-called principle of the authorities in charge of various types of ecological protection red line not to reduce the scale of various types of nature reserves, which makes it extremely difficult to make adjustments. The scope and accuracy of the spatial elements delineated in the original various types of protection plans cannot meet the precision requirements of national spatial planning, and there is also a large error with the results of the “three adjustments” (Figure 4), which makes coordination difficult and the workload is huge.

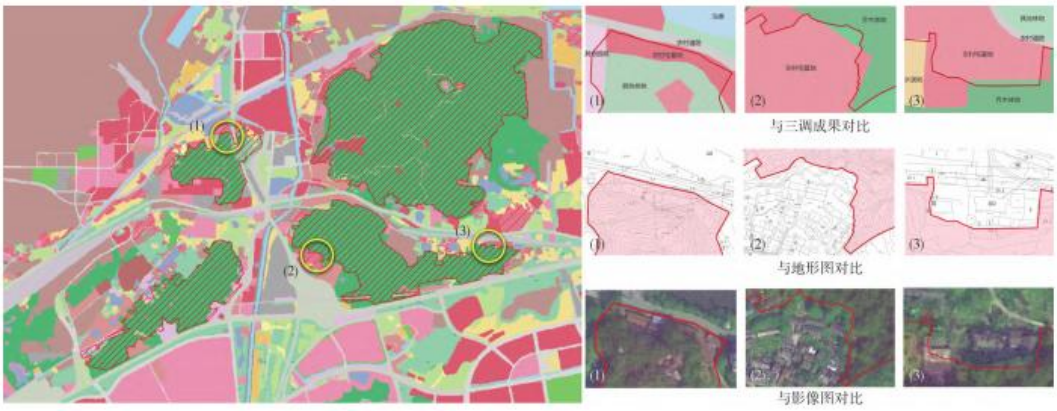

Fig.4 The ecological protection red line before the optimization of a national forest park

2.2.2 Different types of ecological spatial control requirements are inconsistent, making it difficult to implement ecological protection red line control with consistent standards.

Before the institutional reform, the control of ecological space in China had long been managed in a horizontal and sub-sectoral way, and was dispersed among the former land, agriculture, water conservancy, forestry, environmental protection, urban and rural construction, etc., and it was difficult to unify the source of the boundaries of the regions, the criteria for inclusion, and the procedures for adjustments. For example, in a city in the eastern region, there are more than 30 laws, regulations, technical specifications and management methods related to the delineation and control of ecological protection red line involving seven major types (Table 1). In terms of the formulation time, most of the laws, regulations, technical specifications and management measures were formulated before the delineation of the ecological protection red line in 2019, and they lacked convergence with each other.

The integrated and optimized nature reserve is a management scope, usually including areas with ecological functions and other supporting areas, and the management of different types of nature reserves or various functional subdivisions within the same nature reserve according to homogenized control requirements (Table 2) cannot meet the actual needs.

Tab.1 Relevant laws, regulations, technical specifications, and management measures related to the delineation and control of the main types of ecological protection redlines

Ecological space type	The name of the file	Year of Publication	Control	delineate	file type	Issuing department

nature reserve	Regulations of the People's Republic of China on Nature Reserves (Revised in 2017)	2017	√		Laws and Regulations	State council
	Guiding Opinions on the Establishment of a System of Protected Areas with National Parks as the Main Body	2019	√	√	Planning standards	General Office of the Central Committee of the Communist Party of China and General Office of the State Council
	Letter on Doing a Good Job in the Preliminary Work of Optimizing and Adjusting the Scope and Functional Zoning of Nature Reserves	2020	√	√	Planning standards	Ministry of Natural Resources, National Forestry and Grassland Administratio n
	Letter on Doing a Good Job in the Early Stage of Integration and Optimization of Nature Protected Areas	2020	√	√	Planning standards	
Scenic area	Scenic Area Regulations	2006	√		Laws and Regulations	State council
	Regulations on the Administration of Scenic Areas in	2009	√		Laws and Regulations	Jiangsu Provincial People's Congress

	Jiangsu Province (Revised in 2009)					
	"Scenic Area Master Planning Standard" (GB/T 50298-2018)	2018	√	√	Planning standards	Ministry of Housing and Urban-Rural Development
Forest Park	Measures for the Management of National Forest Parks	2011	√		Management Measures	National Forestry and Grassland Administration
	Measures for the Management of Forest Parks (revised in 2016)	2016	√		Management Measures	State Forestry Administration
	Implementation Measures of Jiangsu Province (Revised in 2017)	2017	√		Laws and Regulations	Jiangsu Provincial People's Congress
	Circular of the State Forestry Administration on Further Strengthening the Management of National Forest Parks	2019	√	√	Management Measures	State Forestry Administration
	Measures for the Management of Provincial Forest Parks in Jiangsu Province (Revised in 2021)	2021	√	√	Management Measures	Provincial Forestry Bureau
	Regulations on the Protection and	1995	√		Management Measures	Ministry of Geology and Mineral

Geological heritage reserve	Management of Geological Relics					Resources
	Technical Requirements for the Planning and Preparation of National Geoparks	2016		√	Planning standards	Ministry of Land and Resources
	Regulations on the Protection of the Geological Environment of Jiangsu Province (Revised in 2020)	2020	√		Laws and Regulations	Jiangsu Provincial People's Congress
Wetland Park	Measures for the Management of Wetland Parks in Jiangsu Province	2012	√	√	Management Measures	Provincial Forestry Bureau
	Regulations on the Protection of Wetlands in Jiangsu Province	2016	√		Laws and Regulations	Jiangsu Provincial People's Congress
	Measures for the Management of Urban Wetland Parks	2017	√		Management Measures	Ministry of Housing and Urban-Rural Development
	Provisions on the Protection and Management of Wetlands	2017	√		Management Measures	State Forestry Administration
	Measures for the Management of National Wetland Parks	2017	√		Management Measures	State Forestry Administration
	Guidelines for the Master	2018		√	Planning standards	State Forestry

	Plan of Wetland Parks					Administration
Drinking water source protection zone	Technical Specification for the Classification of Drinking Water Source Protection Areas (HJ/T 338-2007)	2007		√	Planning standards	State Environmental Protection Administration
	"Reply to the Scheme for the Classification of Centralized Drinking Water Source Protection Areas at or above the County Level in the Province"	2009		√	planning	Provincial government
	Regulations on the Prevention and Control of Pollution in Drinking Water Source Protection Areas (2010 Revised Edition)	2010	√		Management Measures	Ministry of Environmental Protection
	Law of the People's Republic of China on the Prevention and Control of Water Pollution (Revised in 2017)	2017	√		Laws and Regulations	National People's Congress
	"Opinions of the Public Office on Strengthening	2017	√	√	Management Measures	Jiangsu Provincial People's Government

	the Management and Protection of Drinking Water Sources in the Province"					
	Technical Specification for the Classification of Drinking Water Source Protection Areas (HJ 338-2018)	2018		√	Planning standards	Ministry of Environmental Protection
	Decision on Strengthening the Protection of Drinking Water Sources (Revised in 2018)	2018	√	√	Laws and Regulations	Jiangsu Provincial People's Congress
	Regulations on the Prevention and Control of Water Pollution in the Yangtze River of Jiangsu Province (Amended in 2018)	2018	√		Laws and Regulations	Jiangsu Provincial People's Congress
	Regulations on the Prevention and Control of Water Pollution in Jiangsu Province	2020	√		Laws and Regulations	Jiangsu Provincial People's Congress
Important fishery waters	Interim Measures for the Management of Aquatic Germplasm Resources Conservation	2911	√		Management Measures	Agriculture

	Areas					
	Fishery Law of the People's Republic of China	2013	√		Laws and Regulations	National People's Congress
	Interim Measures for the Management of Aquatic Germplasm Resources Conservation Areas in Jiangsu Province (for Trial Implementation)	2017	√	√	Management Measures	Provincial Bureau of Oceans and Fisheries
	Regulations on Fishery Management of Jiangsu Province (Revised in 2020)	2020	√		Laws and Regulations	Jiangsu Provincial People's Congress

Tab.2 Functional zoning of different types of protected natural areas

Serial No.	**Type**	**Functional Area**		**Source**	**Ecological Protection Red Line Management Requirements**
1	nature reserve	Core Protected Area	Core	Regulations of the People's Republic of China on Nature Reserves	Core Protected Area
			buffer		
		General Control Zone	Pilot area		
2	Forest Park	Core Landscape Area: refers to the area with particularly precious forest landscape resources that must be strictly protected		National Forest Park Master Planning Code	
		General recreation area: refers to the area where the forest landscape resources are relatively ordinary and it is convenient to carry out tourism activities			

		Management service area: refers to the area demarcated to meet the needs of forest park management and tourism reception services		General Control Zone
		Ecological conservation area: refers to the area that focuses on ecological protection and restoration during the planning period, and is basically not developed and constructed, and is not open to tourists		
3	Scenic area	Ecological Reserve: There is scientific research value or other in the scenic area	"Scenic Area Planning Code"	
		Valuable biological populations and their environment		
		Natural Landscape Conservation Area: Special natural sources and landscapes that require strict restrictions on development behavior		
		Historic Site Reserve: The area around cultural relics at all levels and valuable historical sites of the past dynasties in the scenic area		
		Scenic restoration area: the object and area that need to be restored, cultivated, nurtured, conserved and maintained in the scenic area		
		Scenic area: scenic spots, scenic spots, scenic spots, scenic spots, scenic spots		
4	Geoparks	Landscape structure units at all levels and concentration of scenic tour objects	Technical Requirements for the Planning and Preparation of National Geoparks	
		Cultural Landscape Area: It has a certain range of historical monuments and classical gardens		
		Forests, religious culture, folk customs, etc		
		Comprehensive service area: mainly including park gate area, geological square,		
		Museums, cinemas and areas with visitor services and park management		
5	Wetland Park	Conservation area: An area where no other activities unrelated to the protection and management of wetland ecosystems shall be carried out, except for necessary conservation and management activities such as protection, monitoring, and scientific research	Measures for the Management of National Wetland Parks	
		Restoration and Reconstruction Zone: An area where activities related to the cultivation and restoration of wetlands are carried out		

	Rational use area: an area where publicity and education activities focusing on ecological display and popular science education can be carried out, and ecological experience and management services that do not damage the function of wetland ecosystems		

2.2.3 The actual connotation of the same type of nature reserve varies greatly, and there are challenges in the same standard of management and control.

In similar nature reserves, the ecological sensitivity, ecological constraints and management connotations of different areas have relatively large differences, and all of them are included in the ecological protection red line and unified with higher requirements for management and control, which is more challenging for the ecological space delineation with more anthropogenic activities. For example, although the Qinghai Sanjiangyuan National Nature Reserve and the Nanjing Yangtze River Dolphin Provincial Nature Reserve are both nature reserves, there are big differences in their areas, protection purposes, and actual anthropogenic activities.

2.2.4 The compatibility between ecological protection and agricultural production has been neglected.

The “three lines” demarcation rules make it clear that “the three lines do not cross or overlap”, and that arable land is allowed to be retained in the ecological protection red line area, but permanent basic farmland is not allowed to be retained. In areas where the amount of arable land is lower than the target of permanent farmland protection, the red line of ecological protection is “opened up” in order to complete the task of demarcating permanent basic farmland, resulting in spatial fragmentation of the red line of ecological protection and discontinuity of ecological functions.

2.2.5 Summary of ecological protection red line demarcation

The delineation of ecological protection red line is the second priority in the “three lines” delineation, because the ecological protection red line is limited by the original laws and regulations of various departments, technical standards, and accuracy of the map before the reform of spatial planning, so the central document's institutional design is intended to realize the scientific delineation of ecological protection red line through assessment. However, for various reasons, the phenomenon of “difficult to adjust despite assessment” still exists. There is also a certain disconnect between the red line of ecological protection and the basic farmland protection line, and the coordination between urban development boundaries. At the same time, the guidelines for zoning control of the red line of ecological protection are also derived from various laws and regulations of the original line, and there is an urgent need to establish a “classification system of nature reserves with national parks as the main body, nature reserves as the basis, and various types of nature parks as a supplement”, which will be the rules for the control of each classification zone. The red line of ecological protection is the basic national ecological requirement. As far as the cities in the eastern region are concerned, the red line of ecological protection presents an isolated and dispersed state, and it must not be thought that the red line of ecological protection is delineated and the task of ecological protection is

completed. Territorial spatial planning should make spatial arrangements for the establishment of urban and rural ecosystems in a broad sense.

2.3 Analysis of the Phenomenon of Urban and Town Development Boundary Delimitation

2.3.1 The "fight" for planned construction land in each region has led to a competition to expand the development boundary by a factor of "1.3".

The intensive and appropriate delimitation of urban development boundaries can promote the optimization of the structure and form of urban construction land and the high efficiency of urban operation. The rules on the delimitation of urban development boundaries are gradually being clarified, and the "fight" for planned land for construction has led to a competition to expand the scope of development boundaries by a factor of "1.3". There are two problems regarding the urban development boundary expansion ratio coefficient of "1.3" times: firstly, how to fairly recognize the current status quo base figure of "1", and how to determine the current status quo base figure of "1" by the "WYSIWYG" method of "three adjustments", and how to determine the current status quo base figure of "1". First, the status quo base number "1" how to fairly identify, "three adjustments" status quo construction land scale as "1", omitted part of the reasonable and legitimate status quo approved but not yet used, condoned part of the illegal use of construction land over planning, ignored the efficiency of the land use and intensive and economical level. Secondly, how to guide the development of the new scale "0.3" times, the scope of the urban development boundary should be connected with the conclusions of the scientific prediction of the scale of construction land, taking into account the efficiency of land use, population and economic development trend. The "big pot" leads to some places "not enough", some places "can not eat". In addition, the requirement of non-crossing and non-overlapping delineation and the restriction on the size of new development boundaries have led to the delineation of regional transportation facilities, urban villages, suburban villages, blue and green spaces and other elements that ensure the integrity of the spatial structure of towns and cities from the development boundaries, resulting in the phenomenon of the "opening of the window of heaven". At the same time, the requirement that the existing construction land outside the centralized construction area be allocated to the development boundary has led to the dispersed and fragmented layout of the existing construction land, low land efficiency, and the weak driving force of population and industrial growth in order not to waste the 0.3 times of the new expansion factor, artificially expanding the scale of planned construction land. In areas with weak population and industrial growth drivers, in order to "not waste" the 0.3 times new expansion coefficient, the scale of planned construction land is artificially enlarged, further reducing the level of land use intensification and conservation.

2.3.2 One of the bases for the delimitation of urban development boundaries is the prediction of the scale of urban construction land, but the scale prediction lacks scientific proof.

The delimitation rules determine the expansion coefficient of the urban development boundary according to the ratio of "1.3" times, which is basically the same as that of the whole country, ignoring the development trend of land use efficiency, population and economy, and failing to objectively connect with the conclusions of the scale prediction of the future development of each city. Establishing a scientific and reasonable mechanism for predicting and reviewing the size of cities is one of the key tasks of the current round of territorial spatial master planning. Localities are accustomed to continuing the development path of the past, mechanically using "1.3" times as an indicator, and often putting forward unrealistic scale

demands, which do not match the requirements of the times of shifting from rough development to high-quality development under the new situation.

At the same time, in highly urbanized areas, urban space, agricultural space and ecological space are balanced by mutual constraints, and under the premise of giving priority to guaranteeing the scale and layout constraints of permanent basic farmland and the red line of ecological protection, the scale of urban construction land and the urban development boundary are generally controllable, and will not go beyond the bottom-line control requirements.

2.3.3 The second basis for the delineation of the urban development boundary is the comprehensive analysis of the natural geography and geomorphology, urban transportation corridors and so on.

The delineation of town development boundary is a comprehensive analysis, comprehensive research, the whole region planning process, and natural geomorphology, ecological background, regional transportation conditions, historical and cultural protection, etc., and planning zoning map should be mutually calibrated, deepening level by level. The logical correlation between urban development boundary and urban development scale, urban spatial layout structure and form is more inseparable. When the urban spatial layout is not yet stabilized, the town development boundary delimitation work is very likely to lead to arbitrary boundary delimitation and the phenomenon of fragmentation of the development boundary.

2.3.4 The third foundation of urban development boundary delimitation is the coordination with other two control lines.

The urban development boundary and the arable land, permanent basic farmland, and the ecological protection red line are delineated separately or at a later stage, which leads to the restriction of the degree of construction land concentration and contiguity. As shown in Figure 5, the agricultural population in the area has been transformed into urban population by withdrawing villages and groups, villages have been relocated, and the infrastructure framework has been opened for comprehensive land development, which does not have the conditions for irrigation and drainage of farmland. At this time, it is necessary to match the urban development boundary and the red line of farmland protection, and carry out multiple rounds of mutual correction.

2.3.5 Summary of urban development boundary delineation

The definition of urban development boundary has changed in this round of land spatial planning reform, and there is a misunderstanding of the policy that the development boundary shall not be larger than “1.3” times of the urban construction land of “three adjustments”. Some cities have not made scientific forecasts of urban scale, and have not made comprehensive analysis of natural geography and geomorphology, urban transportation corridors, etc., and have not embodied the scientific requirements for the structure and form of urban layout, and at the same time lacked the process of integrating with the other two lines, which has led to the phenomena of “open window” and “fragmentation” of the development boundary of the cities and towns. “Fragmentation” and other phenomena.

3 Technical logic for the scientific delineation of the “three zones and three lines”.

The key to the scientific delineation of the “three zones and three lines” lies in the integration, not only between the three lines, but also with other elements of the preparation of the overall national spatial planning.

3.1 Clarify the purpose and significance of the delineation of the “three lines”.

First of all, the “three lines” should be used to guarantee the bottom line of agricultural production and national ecological security, control the scale of development, and determine the upper limit of intensive, economical and high-quality development. It is also necessary to balance the spatial relationship between food production, ecological protection and urban development. Secondly, the “three lines” should be used as an integrated governance tool to coordinate the conflict of multiple regulations and promote the modernization of spatial governance capacity. It is necessary to solve the problem of division of traditional planning system and guarantee sustainable development. Finally, the three lines should be used to coordinate the shaping of the urban structure and urban form, and build an overall pattern of ecological protection. As an important hand of construction control, it improves the overall operational efficiency of the city and provides spatial guidance and guarantee for high-quality urban development.

3.2 Establishment of technical routes

The delineation of the “three lines” is relatively ahead of schedule, but it is not an independent stage of work. It must be connected with other important contents of the overall planning of land space, such as urban scale prediction, urban spatial structure and morphology, urban transportation planning, historical and cultural preservation, and shaping of urban characteristics, etc., and at the same time, it must be cross-checked with the planning zoning to ensure the spatial landing. See Figure 6.

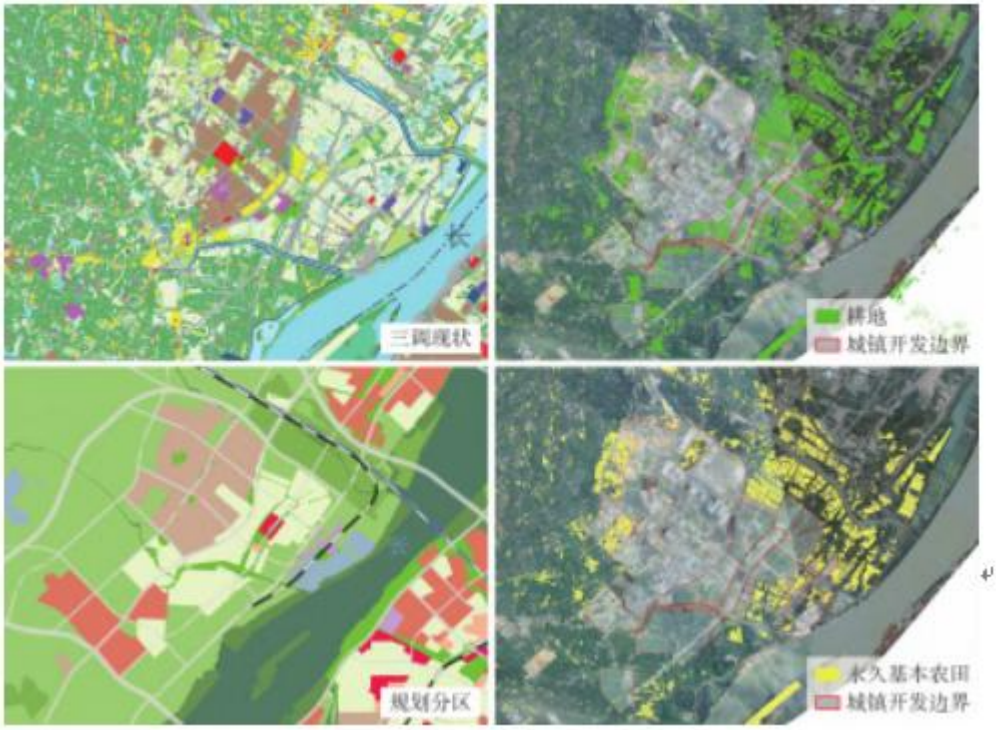

Fig.5 Uncoordinated delineation of three control lines leads to higher degree of construction land fragmentation

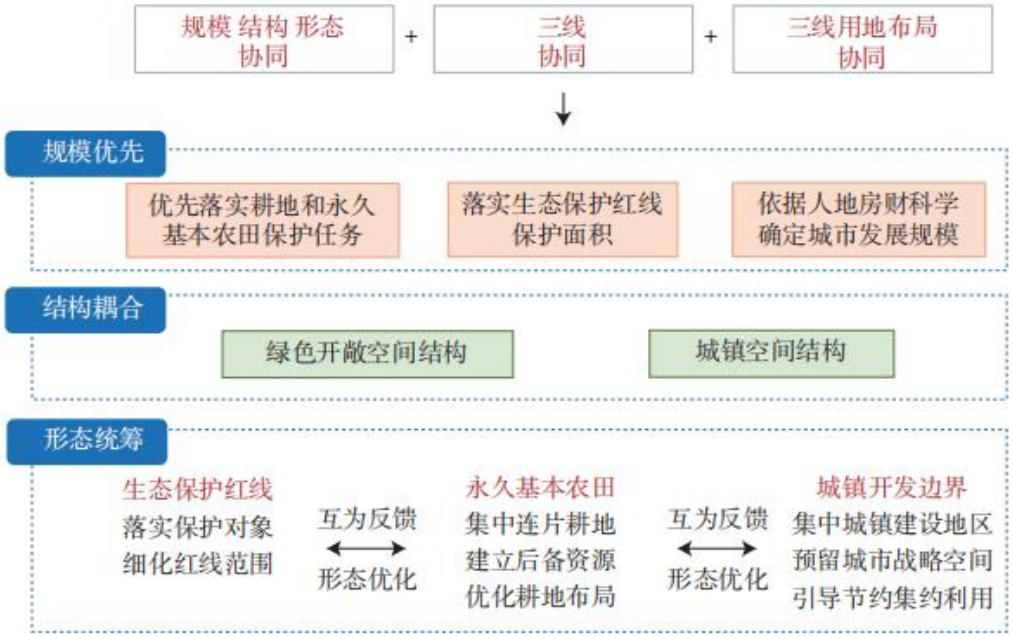

Fig.6 The technical logic of scientifically delineating "three zones and three lines"

3.3 Technical logic of urban development boundary formation

The urban development boundary is the ideal spatial outer contour line delineated in accordance with the principles of optimal spatial structure and highest operational efficiency at the stage of basic stabilization of the urbanization level in the future, under the premise of ecological protection and agricultural production guarantee.

3.3.1 Clarify urban structure and form

First, prioritize the protection of bottom-line space. Construct green open space in the whole area. Based on the analysis of the ecological security pattern, explore the multiple synergistic effects of ecology, recreation, landscape, culture, and increased carbon sinks, shift from the traditional ecological space that favors pure nature to a composite ecological functional space, realize the multi-scale and multi-dimensional spatial nesting of the ecological spatial network and urban spatial pattern, and build a green and open space for the whole region, so as to promote the harmonious development of human and nature, and to promote the diversified livability of human beings and animals and plants. Establishment of a hierarchical and classified protection system. According to the results of the delineation of permanent basic farmland and ecological protection red line, it will be used as the bottom line of the insurmountable and overlapping urban development boundary. Implement the idea of ecological civilization, take permanent basic farmland and the red line of ecological protection as the bottom line, focus on agricultural production space and ecological protection areas, strengthen the protection of animal and plant germplasm resources, and insist on constructing the bottom map of town development with solid agricultural and ecological patterns.

Secondly, we will grasp objective and reasonable data of the current situation and carry out objective assessment and evaluation. In accordance with the requirements of “unified base map, unified standard, unified planning, unified platform”, based on the data of land survey, reflecting both the authenticity and rationality of planning and management, respecting the legitimate rights and interests of construction land, and in compliance with the requirements of relevant

policies and planning and management regulations, forming a land and land survey that complies with the regulations in accordance with the relevant standards and norms of land-use and sea classification and determination of the scope of urban areas. On the premise of complying with relevant policy requirements and planning and management regulations, form a base map of the current state of land and space utilization and a base for planning and preparation work in accordance with the regulations. Focusing on the actual characteristics of natural patterns and development locations, it optimized the development and protection patterns of land space, improved the positioning of regional main functions, and delineated the three control lines, so as to provide a basic basis for the implementation of ecological restoration of land space and major projects for comprehensive land improvement.

Third, optimizing and guiding spatial layout. Consider the urban development strategy, clarify the direction of urban development, and optimize the urban form and layout. Highlight the functions of the urban system, reserve development space for the construction of major facilities and major strategic opportunities for urban development, and promote the efficient operation and sustainable development of cities. Considering the differences in resources and land use structure of different regions, it manages inefficiently utilized and unutilized land, and promotes differentiated land management for the coordinated development of urban and rural areas.

3.3.2 Scientific prediction of construction scale

First, protection priority and balanced development need to be studied simultaneously. Urban scale prediction should be based on the constraints of ecological security and food security, such as water resources, land resources, and “double-carbon” targets, so as to scientifically predict the limit scale and set the upper limit. Secondly, it is necessary to combine individual forecasts with mutual calibration. Scale forecasts include individual forecasts of population, GDP, and construction land scale, as well as cross-checks of people, land, and economic indicators. Third, the absolute value should be cross-checked with the average value and growth rate. It is necessary to consider the absolute value of the scale, but also to assess the level of per capita GDP, per capita construction land, and per capita GDP, as well as to assess the average annual GDP growth rate and the relationship between the growth rates of per capita GDP, per capita construction land, and per capita GDP. Fourthly, it is necessary to combine the level of housing with the optimization of construction land structure. Based on the per capita housing area and the average volume ratio of urban residential land, the scale of residential land should be predicted, and the proportional structure of residential land and urban construction land should be coordinated.

3.3.3 Give full consideration to strategic reservation

The area enclosed by the urban development boundary is the area where urban development and construction are concentrated and can meet the needs of urban production and life, and can be regarded as the urban development area, which mainly includes the urban concentrated construction area, the urban flexible development area and the special use area. Among them, those reserved for the control of major strategic functions of the town in the long term can be combined with the white space in the centralized construction area and the flexible development area of the town to make a coordinated layout.

4 Practical Exploration of Nanjing's Three-Line Delineation

Nanjing is a city of low mountains, hills and hills, plains and continents, with an excellent natural background of mountains, water, forests, fields and lakes, and a flat topography, making it suitable for planting and urban construction. However, it is also because the city's land space has a “multi-desirability” that there are certain contradictions and difficulties in the development and protection of land space. Nanjing has explored the mode of scientific and integrated delineation of the three control lines in conjunction with the preparation of the master plan.

4.1 Constructing an ideal spatial structure

Adhere to the ecological view. Based on prioritizing the determination of ecological space, coordinating the contradiction of different standards and uncoordinated layout of natural resources, adhering to the bottom-line thinking, integrating the life community of mountains, water, forests, fields, lakes, grasses, sand and ice, linking the multi-scale space of the region-city-central urban area, and based on the analysis of the pattern of ecological security, realizing the ecological spatial network, urban spatial pattern, and other multi-scalar and multi-dimensional spatial nesting, constructing green open space in the whole region, establishing a belt with two rings, ten pieces and multiple corridors of ecological security pattern (Figure 7), establishing an ecological spatial control system from the perspective of constructing an ecological security pattern at the municipal level, and forming a kind of reverse planning space to form a reverse constraint on the buildable space.

Adherence to the system view. At the municipal level, from the perspective of Nanjing's natural geographic pattern and long-term spatial structure, the ideal spatial pattern for the whole region of “north-south idyll, central city, river-supporting development, and urban-rural integration” has been established (Fig. 8), and the relationship between the central urban area and the periphery's relatively independent clusters in terms of space, function, and transportation has been handled in a better manner, and the optimization of the spatial layout of the national territory has been promoted continuously. It also continues to promote the optimization of the spatial layout of the national territory. The central metropolis refers to a highly urbanized area within a radius of 40 km, centered on Xinjiekou, with a high density of population, developed economic and industrial functions, a complete system of blue and green spaces, and a high-quality living environment, and it is also the metropolitan area that Nanjing has always insisted on. At the metropolitan area level, the metropolitan area pattern of “multi-centers and axial clusters” will be continuously consolidated. “Multi-centric” refers to the establishment of anti-magnetic centers serving different regions and areas; ‘open’ refers to the establishment of ecological networks in line with towns and cities, and the formation of six ecological green wedges; ‘axial’ refers to the establishment of a network of major towns and cities along rapid transportation corridors, and the formation of six ecological green wedges. is a radioactive town development axis formed by major towns along rapid transportation corridors; “clusters” refers to town units distributed at intervals along radial transportation corridors with the main city as the core, in accordance with the bead pattern of towns on the town development axis.

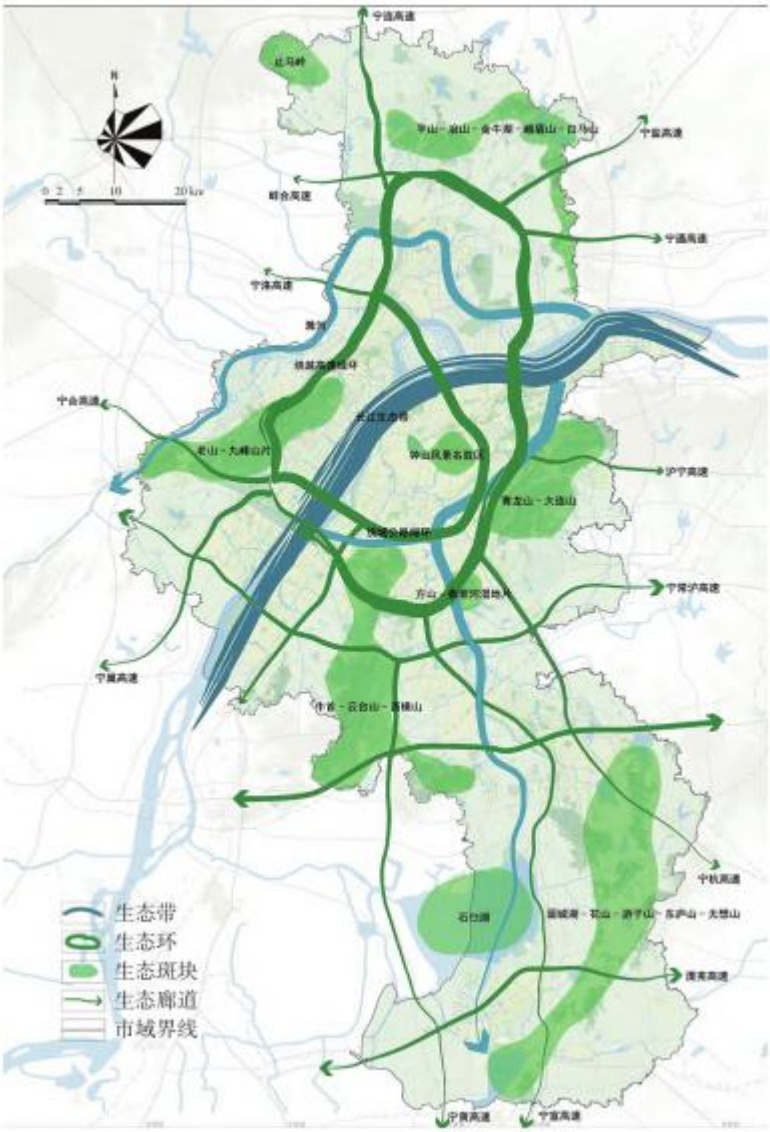

Fig.7 Ecological security pattern of Nanjing

4.2 Scientific Scale Forecast

Considering the relationship between economic and social development and ecological security, food security and energy security, adopting the comprehensive forecasting method of "population-economy-construction land" absolute amount and per capita land average standard, absolute amount and growth rate of each other with multi-factors checking, and analyzing the indicators of people and land in a systematic and comprehensive way, The systematic and comprehensive analysis of human, land, economic and other indicators is carried out. With the combination of various forecasting methods, it is predicted that the resident population will be controlled at around 13 million people in 2035, and the GDP will be around 3.5 trillion yuan; the average added value of construction land and the non-agricultural added value of construction land per unit of urban construction land will be doubled, and the per capita full-caliber construction land and per capita urban construction land will both decrease steadily; and based on the above scales, it is predicted that the scale of the construction land will be scientifically predicted. The result of this prediction fully reflects the requirements of high-quality

development: per capita GDP reflects the requirements of labor productivity improvement, per capita GDP reflects the requirements of high-quality development, and per capita construction land reflects the requirements of high-efficiency and intensification.

4.3 Calibration and Integration between the Three Lines

Scale, structure and form, together constitute the task of delineating the three lines. When coordinating the three lines, the systematicity and integrity of each of the three types of space should be considered in an integrated manner, so that there can be no single line of thinking. First, guarantee agricultural production safety, serve rural revitalization, and form an agricultural and rural pattern. Implement the priority order of arable land protection, realistically determine the target of arable land protection and delineate permanent basic farmland. Secondly, ecological priority is given to strictly abiding by the bottom line, respecting the integrity and connectivity of the ecological network of the whole region, and constructing the relationship between the bottom of the scientific map. Third, adhere to the concept of saving, intensifying and compacting, rationally optimize the urban development boundary and construction land layout, and face the challenges of multiple opportunities brought by the uncertainty of urban strategy and development, which should be considered comprehensively in territorial spatial planning. In general, the three types of space are comprehensively coordinated and delineated in an integrated manner to seek the optimal solution of spatial layout.

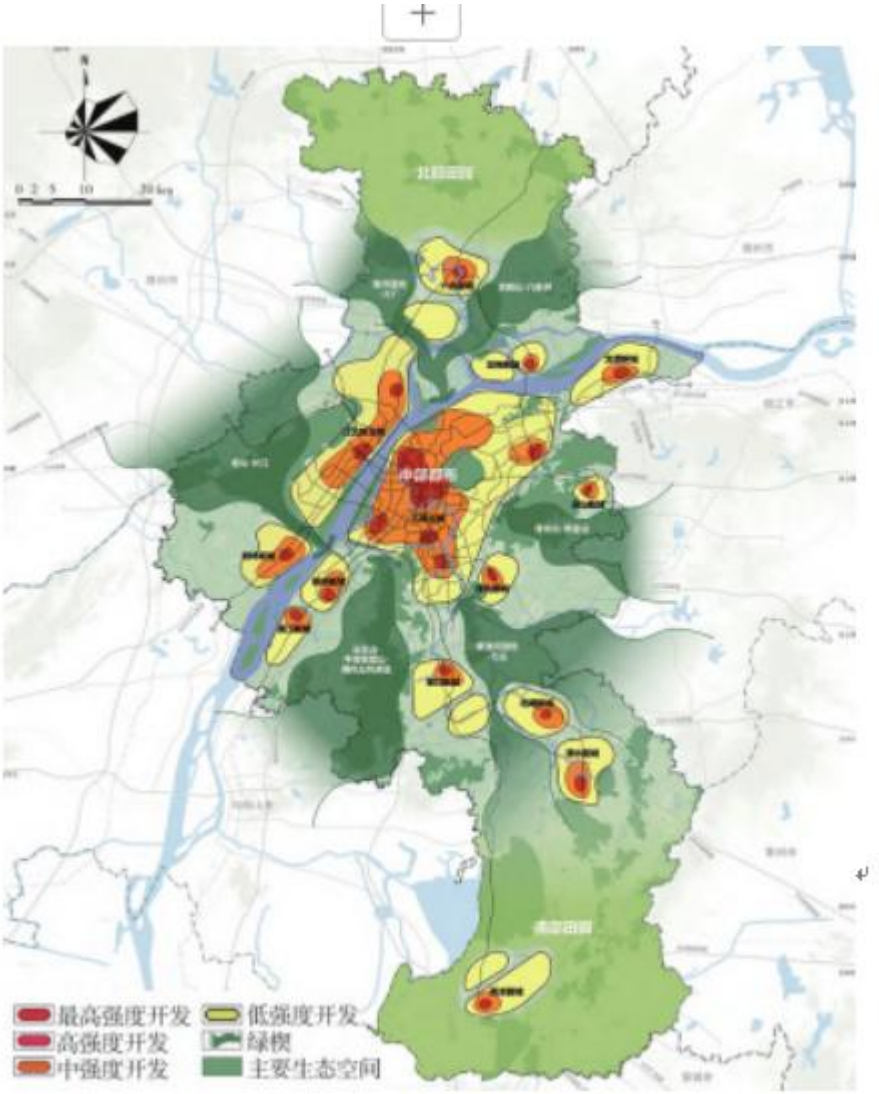

Fig.8 The ideal spatial pattern of Nanjing

5 Reflections and Suggestions

After the delineation of the “three zones and three lines”, it is necessary to study the establishment of a management platform and implementation system for further scientific optimization of the spatial pattern of the national territory, so as to achieve both principles and a certain degree of flexibility.

5.1 Simultaneous completion of the delineation of the “three lines” and the overall planning of national land space

The “three zones and three lines” are important elements in the preparation of the overall plan for national land space, and should be completed in synchronization with the overall plan for national land space. Permanent basic farmland and red line for ecological protection should protect the bottom line space without compromise to ensure agricultural production and ecological safety; the urban development boundary limits the upper limit and layout of urban construction to ensure high-quality development. At present, new optimization rules should be established when the “three zones and three lines” are approved before the overall plan of land space.

5.2 Allow the establishment of arable land preparation zones as permanent basic farmland reserves.

At present, 90% of the long-term stable utilization of arable land is allocated to permanent basic farmland, and the remaining 10% of arable land is not enough to arrange for the balance of new construction land within the development boundary, and there is a lack of supplementary reserve space for major projects to occupy and re-designate permanent basic farmland in the future. To speed up the establishment of arable land reserve area and comprehensive rural land improvement system, it is recommended to allow the designation of a certain scale of arable land reserve area outside the permanent basic farmland, and through the comprehensive rural land improvement, the comprehensive improvement of contiguous rural land, the construction of high-standard farmland, the construction of beautiful countryside and the new arable land integrated.

5.3 Further Precision and Systematization of Ecological Protection Space Delineation

The current ecological protection red line is a narrow concept, and it should be based on the ecological function space and extended outward to build a wide-area green open space system. It is necessary to realize multi-scale and multi-dimensional spatial nesting such as ecological spatial network and urban spatial pattern on the basis of ecological red line delineation to build an all-area green ecological space system, and further unify and clarify the management rules of various types of ecological red line grading and classification.

5.4 The delimitation of urban development boundary should take into account the strategic opportunities for the future development of the city.

It is necessary to shape a reasonable urban structure, optimize urban land layout, coordinate planning, reserve flexibility, and actively respond to the uncertainty of urban development. It is recommended that the delineation of urban development boundary should identify the strategic opportunity space of the city, delineate the strategic reservation area, make it clear that the area will not occupy the planning space index in the planning preparation stage, and will not consider the public facilities and infrastructure support, and strictly control the construction before the arrival of major opportunities.

5.5 Establishment of dynamic adjustment mechanism for the three control lines

It is recommended that the implementation of the three control lines should establish a systematic dynamic adjustment mechanism, such as occupying one to compensate for another, so as to ensure that the implementation of the “three zones and three lines” is serious, coordinated, comprehensive and conductive.

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