

## RESEARCH ON TOPIC SELECTION OF NATIONAL MAIN FUNCTIONAL AREA PLANNING ATLAS

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### ABSTRACT:

In the face of the problems that have emerged along with the rapid industrialization and urbanization in China in recent years, the country proposes to compile the national main functional area plan, divides the national land space into four types of main functional areas: optimized development, key development, restricted development and prohibited development, and carries out the compilation of the national main functional area plan at two levels: national and provincial. The spatial evaluation indexes of the country and the results of the main functional area planning are expressed graphically in the form of thematic maps to make them visual, intuitive and easier to understand. In this paper, we study the topic selection of the National Atlas of Main Functional Area Planning, and mainly introduce the research results of the atlas in topic selection research, content structure design and layout design based on the comprehensive analysis of national and provincial information and following the principles of topic selection.

## 1. INTRODUCTION

In the face of the problems that have arisen in recent years along with China's rapid industrialisation and urbanisation, the State has proposed the preparation of a national main functional area plan, dividing the national land space into four types of main functional areas: optimised development, key development, restricted development and prohibited development, and carrying out the preparation of a national main functional area plan at two levels: national and provincial.

The national planning of the main functional area is a major initiative to comprehensively implement the scientific concept of development and build a harmonious socialist society, which is an innovative work in China. (Li *et al.*, 2021; Cao *et al.*, 2021; Liu *et al.*, 2021) Therefore, it is necessary to compile a set of "National Atlas of Main Functional Area Planning" to graphically express the indicators of territorial spatial evaluation and the results of main functional area planning in the form of thematic maps, so as to make them visual, intuitive and easier to understand.

After carrying out preliminary research on the national main functional area planning sub-indicator system, academic discussions on the practice and theoretical methods of main functional area zoning, the technical regulations of national and provincial main functional area zoning were prepared and revised and improved for many times. The data integration

process was carried out according to the preliminary index system, mainly including: remote sensing monitoring data, socio-economic statistics, basic geographic data and sectoral professional data. A series of basic geographic base maps at scale were formed, and more than 60 thematic maps were produced, including different types of evaluation and analysis maps of different indicators and planning results maps, which were used as illustrations, annexes or maps for presentation of leaders' speeches in the zoning report. At the same time, experiments on the mapping of the main functional areas were conducted, and the basic mapping requirements for national and provincial zoning results maps were designed and proposed, specifying the selection of the content of the basic geographical elements, the expression of the thematic elements of planning, the relevant graphic symbols and projection parameters for different types of zoning maps, ensuring the consistency of the design of the series of maps and facilitating the integration and consolidation of the provincial zoning maps, thus laying a good foundation for the preparation of the national main functional area It has laid a good foundation for the preparation of the National Atlas of Main Function Area Planning. (ZHAO *et al.*, 2017)

This paper examines the topic selection of the National Atlas of Main Functional Areas Planning. Based on a comprehensive analysis of national and provincial sources and the principles of content selection, it introduces the research results of the atlas in

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terms of topic selection, content structure design and layout design.

## 2. RESEARCH ON TOPIC SELECTION

### 2.1 Design Philosophy

An atlas is a complex system with earth science at its core, a fusion of multiple disciplines, and expressed using the language of maps. It covers various fields such as physical geography, politics and economy, and social culture, etc. It is a horizontal level consisting of natural science, social science and transversal science on the one hand, and a vertical level consisting of theoretical science, technical science and applied science on the other, forming a multi-layered, cross-cutting and synergistic science. (Wang., 2011; Zhu *et al.*, 2004)

In the 20th century, the rapid development of horizontal sciences such as systems theory, cybernetics and information theory provided powerful tools for the development of an integrated way of thinking. In turn, the systems science approach, as represented by them, has provided a powerful tool for scientific understanding. (Chen., 2005; Wei., 2012)

In the face of this complex atlas scientific system, we need to have a strong "system view" when analysing problems and dealing with them. Therefore, in order to do a good job in the selection of research and achieve valuable, groundbreaking and feasible results, we need to use the ideas and methods of system theory to systematically analyse, design and deal with them, forming a systematic holistic awareness. Ultimately, a well-structured, hierarchical, interconnected and systematically complete atlas selection is created.

Topic selection cannot be separated from the support of information. The main functional area planning has gone through several stages, from the initial research on the national main functional area planning sub-indicator system, the academic discussion on the practice and theoretical methods of main functional area zoning, the preparation of technical regulations on the division of main functional areas at the national and provincial levels, the development of experiments on the mapping of main functional areas, the selection of the content of basic geographical elements for different types of zoning maps, the expression of the thematic elements of planning, the relevant diagrammatic symbols, the design of projection parameters, etc., the basic cartographic requirements of national main functional area planning result maps and provincial result maps were proposed, and a large amount of textual information, data and base map information were accumulated. These materials and data have laid a rich information base for the planning of the topic and the conception of the content of the National Atlas of Main Functional Area Planning.

The selection of the topic of the National Atlas of Functional Area Planning is the result of refining, concentrating and sublimating a large amount of text, pictures and statistical information; the innovation of the selection is also the application of creative thinking, the adoption of scientific methods and the original planning of the selection and conception of the content; in essence, the innovation of the selection is a kind of cultural design, cultural creation and cultural guidance, a kind of editorial productivity and cultural

productivity. (Yu., 1998) Therefore, proactively planning the selection and conceptualisation of content is an important and creative part of atlas design.

### 2.2 Principles of Topic Selection

The capacity of the National Atlas of Functional Area Planning is limited, while the information on the area to be expressed and the various content options are unlimited. To use the limited capacity to accommodate unlimited contents, there must be "trade-offs", retaining the main information and discarding the secondary information, which is also the basic principle of cartographic synthesis. The selection of the topic of the National Atlas of Main Functional Area Planning is based on the nature, mission and target audience of the atlas, making full use of the three principles of "unity of wholeness and regionality, combination of spatio-temporality and logic, and balance of universality and typicality".

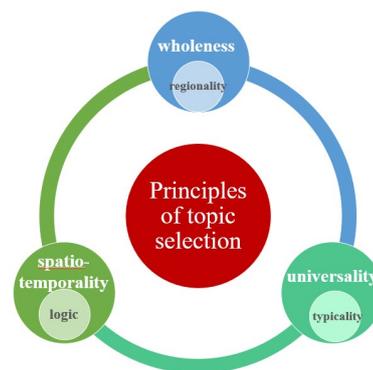


Figure 1. Principles of topic selection.

Through systematic analysis and processing, scientific classification, and strict screening methods and means, comprehensive indicators with planning, evaluation characteristics and regional features are selected as the main topic selection, and these comprehensive indicators and representative data are visually expressed through the form of "thematic map + information graphics".

**2.2.1 The Unity of Wholeness and Regionality:** The unity of the wholeness and the regionality is the basic principle for the selection of topics and the conception of the content of the atlas. It requires designers to have not only a sense of the whole but also to consider the specific situation of the region when planning the selection of topics and conceptualising the content, so that the whole and the regional are harmonised and perfectly combined. (Li *et al.*, 2016)

The Atlas of National Functional Area Planning consists of map groups and maps, which interact, influence, interrelate and constrain each other, forming an organic whole. In addition to the complete expression of the general indicators of the planning and spatial evaluation of the national main function area, the specific indicators of the planning and spatial evaluation of each province, autonomous region, municipality directly under the Central Government, special administrative region and Xinjiang Production and Construction Corps are also expressed in detail. It avoids the mutilation or over-generalisation of regional content.

The principle of unity between the whole and the regional has opened up a wide range of ideas and broadened the horizons for

the study of atlas topic selection and structural layout design, laying the philosophical foundations of atlas theory.

### 2.2.2 The Combination of Spatio-temporality and Logic:

The combination of spatio-temporality and logic is the systematic framework for the planning and selection of topics and conceptual content of the atlas. The National Atlas of Main Functional Area Planning is to complement the preparation of national and provincial main functional area plans, and the selection of topics and conceptual content must be in line with the temporal sequence and spatial scale, as well as logical and causal relationships.

Spatio-temporality is the main line of the atlas planning selection and conceptual content. Fully grasping the time sequence and spatial scale is an important guiding significance for comprehensively and systematically presenting the present and future of the main functional areas at both national and provincial levels. (Li *et al.*, 2011) Logic is a systematic requirement for the selection and conceptual content of the atlas planning. The selection of the atlas is top-down, and without the systematic analysis of the atlas selection, there would be no temporal and spatial composition of the atlas selection, and no logical arrangement of the atlas selection. The main functional areas at the national and provincial levels are themselves a large multi-factor and multi-level system, which includes not only the strategic pattern, the division of main functional areas and the distribution of various types of main functional areas, but also the results of regional evaluation by the national spatial evaluation indicators, which interact with each other and develop together. Therefore, adopting the expression form of atlas to systematize it can better express its internal structure and multi-level relationship than a single map, which is conducive to comparing with each other and further demonstrating the achievements of the main functional areas at national and provincial levels.

The combination of spatio-temporality and logic not only ensures the spatio-temporality of the topic selection of National Atlas of Main Functional Areas Planning from the structure, but also ensures the logic of the content selection from the topic, so that the spatio-temporality and logic of the content selection can reach an organic combination.

### 2.2.3 The Balance between Universality and Typicality:

The balance between universality and typicality is a theoretical requirement for the selection of topics and the conception of the contents of the atlas, which, in a philosophical sense, is the unified relationship between the universality and specificity of contradictions. (Jia., 2001) As a thematic atlas presenting the results of national and provincial planning for the main functional areas, the National Atlas of Functional Area Planning must be rich and comprehensive in its selection of content, with basic overviews, planning and evaluation categories all represented.

For this reason, when planning the selection of topics and conceiving the content, it is necessary to analyse systematically and classify scientifically the information and data collected on planning and evaluation research results, etc., so as to find typical topics with planning and evaluation characteristics and local features, and to establish a correspondence between universal and typical topics.

The balance between universality and typicality not only ensures the universality of the topic of the National Atlas of Main Functional Areas Planning as a whole, but also highlights

the typicality of the content selection from a local perspective, so that the universality and typicality of the topic selection achieve a mutual balance and complementary effect, avoiding gaps or overlaps in the topic selection.

## 3. CONTENT STRUCTURE DESIGN

An atlas is not a mechanical combination of various maps or a simple patchwork, but a complete system of maps that are organically linked and complementary to each other. It is a collection of maps that is formed according to certain cartographic purposes and uses. (Wang., 2014; Wei., 2012; Zhu *et al.*, 2004) The structural design is the concrete expression of the research results of the topic selection. A reasonable structural design allows the whole atlas to have new functions in operation that are different from those of the components.

The most important features of the atlas are its systematic and logical nature, both of which are reflected in the structural design of the groups and the logical arrangement of the panels. In terms of structural design, the structure of the atlas is "atlas + map group + map". In terms of layout, the principle of "macro, then meso, then micro; basic, then thematic; graphic, then text" is followed.

In considering the weight, sequence and coordination of the various types of maps, the atlas is always systematic and logical in its thinking, building the main framework structure of the atlas in terms of both spatial zoom and content themes, with a national and provincial administrative structure evident vertically according to spatial scale, and a number of categories horizontally according to content themes. The overall structure of the atlas is shown in the figure below.

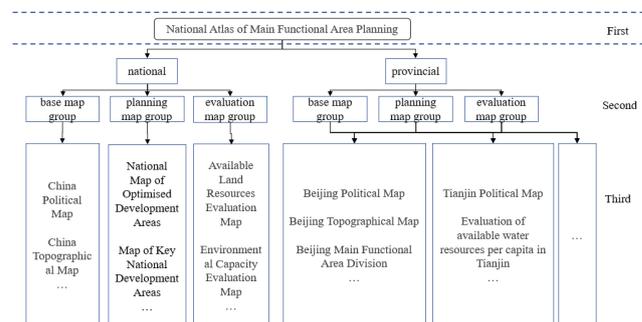


Figure 2. Overall structure of the National Atlas of Main Functional Area Planning.

### 3.1 First Level Structure - Atlas

The primary structure of the atlas is the atlas itself, which is made up of several groups of maps representing different themes. The structure of the content of each group and the way they are arranged and combined directly affects the overall quality and scientific value of the atlas. The atlas is designed as an A4 opening volume, and due to the large number of resultant maps, it can be divided into three volumes: upper, middle and lower, in the order of administrative codes, from the national to the provincial levels. The upper volume consists of eight provincial units, including Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia Autonomous Region, Liaoning, Jilin and Heilongjiang provinces in the national and north-eastern regions of China, the middle volume consists of 13 provincial units,

including Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangdong, Guangxi Zhuang Autonomous Region and Hainan provinces in the eastern and southern regions of China. The lower volume consists of 14 provincial units, including Chongqing, Sichuan, Guizhou, Yunnan, Tibet Autonomous Region, Shaanxi, Gansu, Qinghai, Ningxia Hui Autonomous Region, Xinjiang Uygur Autonomous Region, Xinjiang Production and Construction Corps, Hong Kong Special Administrative Region, Macao Special Administrative Region and Taiwan Province in the southwest, northwest, Taiwan, Hong Kong and Macao regions. The top, middle and bottom volumes are roughly equal in number and balanced in thickness. In order to reflect the integrity of the atlas, the Hong Kong, Macao and Taiwan regions have been treated as uninformative and are only included in the political district maps.

### 3.2 Second Level Structure – Map Group

The atlas is logically arranged with spatial scale as the main line and thematic combinations as the supplementary line between the groups of maps. At the spatial scale, the national and provincial level structure is used to gradually increase the resolution and refine the representation content, forming the main line of the hierarchical spatial structure of the national-level main functional area planning results and the provincial-level main functional area planning results. The three map groups of national-level main functional area planning results, namely: base map group, planning map group and evaluation map group, while the numerous provincial main functional area planning results are divided into 31+1 units according to the provincial administrative division code, and each provincial unit can also be implicitly divided into three map groups, namely: base map group, planning map group and evaluation map group.

In terms of thematic combinations, the first is the base map group reflecting the overall overview, followed by the planning map group reflecting the schematic map of the strategic pattern, the general map of the division of the main functional areas and the distribution of various types of main functional areas, and finally the evaluation map group reflecting the results of spatial evaluation, forming a logically ordered thematic arrangement of supplementary lines. The composition of each map group is introduced separately below.

**3.2.1 Base Map Group:** The base map group is the positioning basis for the expression of the thematic elements of the main functional area, including the political area and the topography (image), of which the political area map must represent the elements to the county boundary, but also the names of major towns, major rivers, major traffic routes and other geographical elements. The topographic map is a rendering of the geomorphological halo generated by DEM data, and the image map is the result of data fusion between different images, both of which are background elements set to enhance the expression effect of thematic elements of the main functional area and to express thematic contents scientifically.

**3.2.2 Planning Map Group:** The planning map group is the final graphic expression of the results of the main functional area planning, including three forms: the strategic pattern schematic map, the general map of the division of the main functional area and the distribution map of various main functional areas.

1) Strategic pattern diagram: refers to the strategic pattern diagram of urbanisation, agriculture and ecological security, with a topographic map using a halo rendering for the background of the base map. The basic framework and general distribution characteristics of the strategic pattern are expressed in a general way through a high degree of condensation and abstraction of the specific urban, agricultural and ecological distribution maps, using relatively concentrated pieces, important points, major axes, conceptual circles and arrows pointing to the layout.

2) General map of the division of the main functional areas: a summary map of the results of the division of various main functional areas at the national and provincial levels, with the base map using the county-level administrative division as the basic unit of the political map.

3) Distribution maps of various types of main functional areas: namely, "optimised development areas", "key development areas", "restricted development areas (key ecological function areas)", "prohibited development areas", and a distribution map for each type of development area, with each distribution map distinguishing between national-level and provincial-level main functional areas. The base map is unified using the county-level administrative division as the basic unit of the political map.

**3.2.3 Evaluation Map Group:** The evaluation map group refers to the result map of the province's evaluation according to the national spatial evaluation indicators, including: sub evaluation maps of land resources, water resources, ecological vulnerability, ecological importance, environmental capacity, natural disaster risk, population, economy, transportation and resources. Except for the ecological evaluation map, which uses national units, the evaluation base maps of other indicators use sub-county administrative division base maps

### 3.3 Tertiary Structure - Map

The map is the most basic unit of the atlas, and there is often a close connection between the maps. Each map in this collection basically occupies an unfolded page, whose content selection, cartographic expression and editorial processing directly affect the accuracy and quality of the collection. The following is based on the division of the map group, respectively selected 1 typical sample map to explain.

The Topographical Map of China: highlights the physical geographic elements of China, such as topography, rivers and mountains, while other human geographic elements are briefly represented as supporting information. The accompanying map of China's political regions highlights the human geographic elements such as administrative divisions and boundaries, settlements and place names, and transportation, while other physical geographic elements are briefly expressed as spatial positioning information.

Strategic pattern map: A strategic pattern map for urbanisation, agriculture and ecological security, with a topographical map using a halo rendering in the background. By highly condensing and abstracting the specific distribution maps of urbanism, agriculture and ecology, the basic framework and general distribution characteristics of the strategic pattern are expressed in a general way, using relatively concentrated pieces, important points, major axes, conceptual circles and arrows pointing to the layout.

Ecological Vulnerability Overall Evaluation Map: In general, topography, geomorphology, climate, hydrology, soils and geology can be used as potential vulnerability factors, while vegetation cover, soil erosion, land use and socio-economics can be used as coercive vulnerability factors, and ecological vulnerability is presented in terms of physical and county-level administrative units. The results of the ecological vulnerability assessment are presented in terms of physical geographical units and county-level administrative units.

#### 4. CONTENT LAYOUT DESIGN

The content layout design is the final presentation form of the research results of the topic selection. The National Atlas of Main Functional Area Planning is prepared by combining the results of national and provincial main functional area planning, and expresses the spatial evaluation indicators of the country and the results of main functional area planning in the form of thematic maps, making them visual, intuitive and easier to understand. Therefore, the content of the National Atlas of Main Functional Area Planning includes two parts, namely the results of national-level main functional area planning and the results of provincial-level main functional area planning, as follows.

##### 4.1 National Main Functional Area Planning Results

###### 4.1.1 Base Map Group

- 1) China Political Map
- 2) China Topographical Map
- 3) China Image Map

**4.1.2 Planning Map Group:** This map group contains four types of maps.

- 1) National Map of Optimised Development Areas
  - Bohai Sea Rim Planning Map
  - Yangtze River Delta Regional Planning Map
  - Pearl River Delta Regional Planning Map
- 2) Map of Key National Development Areas
  - Central Plains Regional Planning Map
  - Planning map of the middle reaches of the Yangtze River
  - Chengdu-Chongqing Regional Planning Map
  - Guanzhong District Planning Map
  - Beibu Gulf Area Planning Map
- 3) Map of National Restricted Development Areas
  - Planning map of the Greater and Lesser Hingganling Forest Ecological Function Areas
  - Map of the Changbai Mountain Forest Ecological Function Area
  - The Sichuan-Yunnan Forest Ecology and Biodiversity Functional Area Plan
  - Qinba Biodiversity Functional Area Planning Map
  - Planning map of forest ecological function areas on the edge of the southeastern Tibetan plateau
  - Plan of the Altai Mountain Forest Ecological Function Area
  - Qinghai Sanjiangyuan Grassland Meadow Wetland Ecological Function Area Plan
  - Tarim River Desert Ecological Function Area Planning Map

- Plan of the Arjin grassland desert ecological function area
- Planning Map of the Qiangtang Plateau Desert Ecological Function Area
- Northeast Three Rivers Plain Wetland Ecological Function Area Planning Map
- Planning Map of the Yellow River Delta Wetland Ecological Function Area
- Planning Map of the Northern Jiangsu Coastal Wetland Ecological Function Area
- Ruorgeri Plateau Wetland Ecological Function Area Planning Map
- Plan of the Ecological Function Area of the Sichuan-Yunnan Dry and Hot River Valley
- Plan of Hulunbuir Grassland Desertification Control Area
- Plan of the Horqin Desertification Control Area
- Plan of Hunsandak Desertification Control Zone
- Map of the Mawwusu Desertification Control Area
- Planning map of the severe soil erosion control area in the hilly gullies of the Loess Plateau
- Soil erosion control zone plan for the Dabie Mountains
- Guizhou-Guizhou Karst Desertification Control Zone Planning Map

4) Map of National Prohibited Areas

- National Nature Reserves
- World Cultural and Natural Heritage
- National Key Scenic Areas
- National Forest Park
- National Geopark

**4.1.3 Evaluation Map Group:** This map group contains nine types of maps.

- 1) Available Land Resources Evaluation Map
  - Graded type evaluation map of available land resources per capita (county-level administrative units)
  - Evaluation chart of the classification type of land development intensity
  - Arable land distribution map
- 2) Available Water Resources Evaluation Map
  - Evaluation map of available water resources potential per capita (county-level administrative units)
  - Water Resources Level 3 Zone Water Resources Evaluation Map
  - Water Resources Development and Utilization Rate Evaluation Map (County Administrative Units)
  - Groundwater over-extraction intensity evaluation map
- 3) Environmental Capacity Evaluation Map
  - Sulphur dioxide emission status distribution map (county-level administrative units)
  - Chemical oxygen demand emission status distribution map (county-level administrative units)
  - Sulphur dioxide environmental capacity carrying capacity evaluation map (county-level administrative units)
  - Chemical oxygen demand environmental capacity carrying capacity evaluation map (county-level administrative units)
  - Comprehensive evaluation map of the environmental capacity carrying capacity of major pollutants (county-level administrative units)
- 4) Ecosystem Vulnerability Assessment Map

- Overall ecosystem vulnerability assessment map (physical-geographical unit)
- Overall Ecosystem Vulnerability Assessment Map (county-level administrative units)
- Soil erosion vulnerability assessment map
- Desertification vulnerability assessment map
- Stone desertification vulnerability assessment map

#### 5) Ecological Importance Assessment Map

- Ecological importance assessment map (physical geographical unit)
- Ecological importance assessment map (county administrative units)
- Map for evaluating the importance of the water-conserving function
- Soil conservation function importance assessment map
- Evaluation of the importance of the function of wind and sand control
- Biodiversity conservation importance assessment map (county administrative units)

#### 6) Natural Disaster Risk Assessment Map

- General assessment map of natural hazard risk (physical-geographical unit)
- General assessment map of natural disaster hazards (county-level administrative units)
- Flood hazard assessment map
- Seismic hazard assessment map
- Typhoon hazard risk assessment map
- Geological hazard assessment map

#### 7) Spatial Evaluation Map of Population Concentration

- Spatial evaluation map of population concentration (county-level administrative units)
- Population density distribution map
- Evaluation chart of population movement intensity
- Town size class distribution map

#### 8) Spatial Evaluation Map of Economic Development Level

- Spatial evaluation map of economic development levels (county-level administrative units)
- Spatial evaluation map of GDP per capita

#### 9) Spatial Pattern Evaluation Map of Traffic Dominance

- Spatial pattern evaluation map of traffic dominance
- Spatial pattern of road network density evaluation map
- Airport and port class impact degree evaluation map
- Spatial pattern of location dominance evaluation map

## 4.2 Provincial Main Functional Area Planning Results

### 4.2.1 Base Map Group

- 1) Provincial Regions Map
- 2) Provincial Terrain Map

**4.2.2 Planning Map Group:** This map group also contains four types of maps, just like the results of the national main function area planning, but with the corresponding provincial areas as the evaluation areas.

**4.2.3 Evaluation Map Group:** This map group also contains nine types of maps, just like the results of the national main function area planning, but with the corresponding provincial areas as the evaluation areas.

## 5. CONCLUSION

The study of topic selection is the core of the overall design of the atlas, and the design of the structure of is the concrete expression of the research results of topic selection. In this paper, the three principles of "unity, integration and balance" are summarised and summarised by applying systemic thinking and system engineering methods. The atlas has been designed to be innovative by using a multi-unit combination of "thematic maps + information graphics".

The research on the selection of topics and the design of the structure of the National Atlas of Main Functional Area Planning is the result of the creators' theoretical research, their review of materials, literature, theoretical innovation and the condensation of the selected topics, as well as the result of the creators' brainstorming, collision of ideas, docking of wisdom and gradual improvement in the concrete innovative practice. It is hoped that the results of this research will be useful and informative for future thematic atlas design, map culture innovation and topic selection ideas.

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