

A Review of Textual Analysis of Policy Tools for Ecological Space Use Control in China based on LDA Thematic Analysis Model

Qian Chen

Nanjing Agricultural University, Nanjing, China

Abstract: This study summarizes the use of natural ecological space use control tools in China in recent decades based on the LDA thematic analysis model, analyzes the development trend of ecological space use control policy tools in China and provides valuable opinions for the future development of natural ecological space use control policy tools and a sound ecological civilization system.

Keywords: LDA; Ecological Space; Use Control; Policy Tools.

1. Introduction

With the accelerated urbanization and industrialization in China in recent years, the population has increased dramatically and the demand for land has been growing. For a long time, China's land use has focused more on the socio-economic characteristics of land and neglected the natural ecological attributes of land. Many natural ecological spaces with unique ecological values have been squeezed and transformed into agricultural and urban spaces, resulting in the decline of regional ecosystem service functions and increased ecological sensitivity, which in turn has led to a series of serious ecological and environmental problems urban development, arable land protection and ecological construction contradictions. According to the data of the second survey, compared with the data of the first national land survey, grassland degradation, arable land reclamation, and construction occupation have led to a decrease of 160 million mu of grassland, 10.7% of mudflats and swamps with ecological support functions, and 7.5% of glaciers and snow.

Ecological spatial control is an important initiative concerning nature protection and human welfare, and it is also an important grasp for planning the coordination of protection and development in the new era of ecological civilization. However, there are still weaknesses in the theoretical research of control, especially in the area of control zoning. At present, the ecological space use control mostly follows the traditional land use planning, main function zoning and other concepts, in which there are many loopholes and problems such as spatial conflicts, insufficient departmental cooperation, etc. There is a lack of objectives and implementation paths that can be widely used in line with the new era, new needs and new concepts.

2. Current Status of Domestic and International Research

2.1. Policy Tools

2.1.1. Classification of Policy Instruments

Regarding the classification of policy instruments, the earliest research on policy instruments was conducted by the Dutch scholar Kirschen, who classified them into 64 types, but he did not systematically classify them, nor did he

theorize about their origins and impacts.

Some scholars classify policy instruments according to the purpose of the instrument, and classify them into legal, economic, and communication instruments from the perspective of how they affect the behavior of actors. Some scholars classify policy tools according to the resources used by the policy, and any tool can be attributed to four government resources: nodal, authority, financial, and organizational, and then these four resources are divided into eight types of policy tools in combination with the government's choice, i.e., influencer or explorer arrangement. Some scholars classify policy tools into four categories according to the purpose of using policy tools, namely, command tools, incentive tools, capacity building tools, and systemic change tools. Based on whether the policy instrument is mandatory or not, different policy instruments can be classified into mandatory, hybrid, and voluntary (or non-mandatory) instruments using the trichotomy of the "policy instrument spectrum". This classification is more concise and explanatory than other classifications, but it cannot be used in the study of policy instruments. Other scholars classify them into direct provision of goods and services by government departments, commissioning by government departments to other departments, contracting out, grants or subsidies, vouchers, operating concessions, government peddling of specific services, self-assistance, volunteering, and market operation according to the degree of government involvement. In this context, the subsequent research on policy instruments started to become extensive and in-depth.

2.1.2. Influencing Factors and Selection Models for Policy Instrument Selection

It is not enough to assess what is a good policy instrument, but more important is the dimension from which the right policy instrument is selected. The general principle of policy instrument selection involves two: the factors that influence instrument selection and how to make the selection.

Hood was the first scholar to explore the influencing factors of policy instrument selection, and he analyzed the influencing factors of policy instrument selection from four aspects of policy instrument substitutability, environmental matching, ethics and morality, and minimum cost, which is a relatively loose framework system. In recent years, the most

research on the influencing factors of policy instruments has been conducted by domestic scholars in China, who proposed that the factors of policy instrument selection include policy objectives, characteristics of the policy instrument itself, the environment of policy instrument selection, limitations of previous choices, and ideological factors. Some scholars categorized the factors influencing the choice of policy instruments into five aspects: policy objectives, characteristics of the instruments, the context in which the instruments are applied, previous instrument choices, and ideology. From the perspective of institutional analysis, an integrative analytical framework can be synthesized in which the choice of policy instruments is influenced by a combination of four vectors: the vector of instrument performance, the vector of actors, the vector of governance problems, and the vector of institutions (i.e., the vector of governance networks).

Policy instruments are ultimately implemented through a selection model. There are few studies on policy selection models at home and abroad. Salamon adopts four analytical dimensions of the degree of coercion, the degree of directness, the degree of autonomy and the degree of visibility to analyze and select policy instruments, which is a new analytical framework, but unfortunately it does not form a systematic system. The earliest model generalization of policy instruments was made by Michael, who summarized the claims of various scholars in policy instrument selection over half a century in his book *Public Policy Studies* and synthesized a model of policy selection, called the integrated model, in which the two major factors that determine policy instrument selection are state capacity and policy subsystem complexity, and the high and low ranking of the two will determine the choice of policy differs. Chinese scholar Zhang Xinwen develops Michael's integrated model on two dimensions of state capacity and social self-management capacity, with the difference that he advocates the use of market-based instruments when state capacity is strong and social self-management is weak, while voluntary instruments are more effective when both dimensions are strong. Zeng Junrong combines social capacity with the complexity of the policy subsystem, divides it into social capacity and social heterogeneity, and constructs a trivariate model together with government capacity.

2.2. Policy Tools and Existing Problems of China's Natural Ecological Space Use Control System

2.2.1. Research on Policy Tools for Natural Ecological Space Use Control in China

There is no complete literature review to summarize the policy tools for natural ecological space use control in China, but by reading a large number of policy documents, we can conclude that the development of policy tools for natural ecological space use control in China is carried out as follows.

For a long time, China has not formed a complete spatial use control system like the control of arable land and urban land, and the use control of natural ecological space is concentrated in the protection of land types such as forests and grasslands, which are only controlled by various departments through land type indicators, such as forest cover and area of national public welfare forests in the forestry department, and basic grassland area in the agricultural department, and in the management through environmental management and restoration projects to reduce human

activities, and implementing restoration projects to reduce the disturbance or damage of human activities.

In 2011, the concept of "ecological red line" was first introduced in a national policy document, clearly requiring the designation of ecological red lines in important ecological function areas, sensitive areas and fragile areas of land and marine ecological environment. Since then, the ecological red line has become an important control tool for various departments, and has formed various ecological red lines such as water resources management red line, marine ecological red line, forestry ecological red line and grassland ecological red line. With the ecological red line becoming an important control tool for various departments to carry out control, the academic community has carried out extensive discussions on the delineation and protection of ecological red line from various aspects such as index system, technical method, control scheme and management method. However, there are still many shortcomings in the current ecological protection red line delineation policy, such as unclear quantitative descriptions in the delineation policy documents. At the same time, the spatial index delineation and spatial index control of the ecological protection red line also have overlapping core control indexes, conflicting index values, inconsistent data statistics, etc., and various planning objectives have their own focus and lack coordination and connection with each other.

The fiscal policy of ecological compensation is also one of the policy tools for natural ecological space use control. It first appeared in policy documents in 2005 and has further improved the ecological compensation system in the following ten years with the establishment of market-oriented and diversified ecological compensation mechanisms and comprehensive compensation systems, and the establishment of cross-regional horizontal compensation measures. Scholars have launched multi-dimensional discussions on ecological compensation diversified ecological compensation mechanisms, ecological compensation pathways, ecological compensation methods, and ecological compensation standards. At present, China's ecological compensation mechanism has problems such as insufficient government finance, different compensation standards, and lack of laws and regulations..

2.3. LDA Theme Model for Natural Ecological Space Use Control Policy Text

2.3.1. Advances in LDA Topic Model Research

The LDA model was mainly developed by foreign scholars and has made great research progress in recent decades. Vector Space Model (1975) firstly proposed the TF-IDF vector space model, which advocated the use of feature words in the text for weighting processing instead of the text. Based on the synonym deficiency of TF-IDF model, Deerwester (1990) proposed latent semantic analysis model (L), LSA model solved the synonym problem, but the algorithm is difficult. Hofmann (1999) proposed PLSA model, which is improved on the basis of LSA model, mainly by the construction of probabilistic model to avoid the former complex computation... Until Blei (2003) formally constructed the LDA model based on the PLSA model, a Bayesian improvement was made to the PLSA model, i.e., a priori distributions were added to the topics and the feature words corresponding to the topics. The dimensionality of the data is greatly reduced by introducing the text topic distribution, and the parameter space size of the model is fixed, independent of the size of the text set itself, so it is more

suitable for large-scale text sets. the variable decibel inference method proposed by Blei is computationally small but not accurate enough, and Griffiths (2004) proposed the Gibbs Sampling algorithm, which is computationally large, but relatively simple and accurate. However, it is relatively simple and accurate, and is the preferred approach in the current text set research, and this paper is also based on Gibbs Sampling for analysis and research.

After that, many scholars at home and abroad have optimized and extended the performance of the LDA model. Ramage et al. proposed the PLDA model by improving the correspondence association between document categories and document masters, assuming that each document's topic class is associated with one or more document category labels respectively, and each document category corresponds to a mixture of multiple topics. Mao (2012) et al. proposed the semi-supervised hierarchical topic model SSDLDA, which fuses labeled topics during text generation to obtain a hierarchical structure about topics. Zhiyuan Liu et al. proposed the PLDA+ model, which uses various strategies such as data placement to improve the parallelization efficiency of the LDA model. Zeng Jia et al. proposed a BP algorithm-based LDA model learning strategy, and experiments on a large-scale document dataset showed that the method outperformed the variational Bayesian and Gibbs Sampling strategies in terms of efficiency and accuracy.

Currently, LDA topic models are widely used in fields involving the analysis of large text sets at home and abroad, including topic evolution trend analysis (Fang Li, 2009), policy text analysis (Mohammadzaman, 2020 & Shuyi Li, 2022), financial finance field (Welzer, 2016) and social media field (Hui-Xiong, 2018). It is a practical model that allows one to quickly grasp the hidden information and patterns behind a large amount of text data.

2.3.2. The Need to Study Policy Instruments using LDA Thematic Models

LDA topic modeling is a common text mining technique that can automatically classify and summarize the topics of a large set of text data, helping researchers to better grasp the hidden information and laws behind the text data. By making good use of LDA theme model, we can fill the research gaps in China and provide a better policy tool that meets our national conditions.

In the study of natural ecological space use control policy tools, the LDA thematic model can play the following important roles: first, the understanding and sorting out of policy objectives. The policy of natural ecological space use control involves very many goals and tasks, such as protecting ecological environment, optimizing planning layout, and promoting ecotourism development. Through the classification and analysis of LDA topic model, the policy objectives can be sorted out and integrated in detail, depicting different themes or topics, and helping researchers to deeply understand the inner logic of policy objectives and tools. Second, the identification and evaluation of policy tools. There is a wide variety of policy tools for natural ecological space use control, and their implementation effects and quality vary. Using the LDA thematic model can help researchers quickly identify different policy tools from policy texts and further evaluate their implementation effects and quality, providing a scientific basis and reference for policy formulation and implementation. Third, the analysis and prediction of policy effects. The implementation of natural ecological space use control policy tools is followed by their

effects. By analyzing the textual data after the implementation of the policy through LDA thematic model, the changes of the policy effects can be monitored and compared, and possible problems and contradictions can be found, so as to further propose improvement plans and predict the future trends of the natural ecological space use control policy. In summary, it is quite necessary to use LDA to study the development trend of existing natural space use control policy tools.

3. Summary

In the process of urbanization and industrialization in China, the conflict between human and land has been intensifying, and many natural ecological spaces have been squeezed by urban or agricultural spaces due to the scarcity of land and its multiple desirability, which has caused many serious ecological problems. However, there are still many defects in the current system of natural ecological space use control, such as inconsistent definition of natural ecological space, inconsistent coordination among various departments, "games" with other departments based on their own "rights", and insufficient supervision. Therefore, in order to create a beautiful China with green water and green mountains, it is necessary to improve the existing natural ecological space use control system. Based on the LDA thematic analysis model, this study will extract the texts of natural ecological space use control policies in recent decades and analyze the development trend of natural ecological space use control policy tools in recent decades, so as to provide references for the future development of better policy tools.

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