

Niche evaluation and evolution path selection of forestry enterprises in Northeast state-owned forest region

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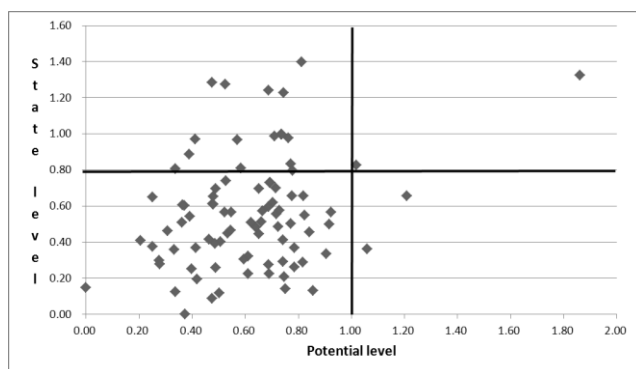
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Graphical abstract



Abstract

On the Basis of Relevant Theory and Literature Research, analyze the development of forestry enterprises in northeast China, and establish the evaluation index system of the ecological situation of forestry enterprises in northeast China. Based on the composite weights of objective and subjective empowerment, the ecological niche and potential of forestry enterprises in Northeast state-owned forest areas were evaluated and establishes the evaluation index system of the ecological situation of forestry enterprise in northeast China. Based on this, the ecological position and potential of forestry enterprises in the northeast of the northeast are evaluated, and the model of the evolution path selection matrix of the northeast state-owned forest is constructed. Finally, based on the development of ecological path dependence and path breakthrough, passive adaptation and initiative adaptation, the functional ecological selection of forestry enterprises in the northeast state-owned forest sector is combined with the ecological potential of the forestry enterprise, which is the economic benefit priority, ecological benefit and the three main benefits. Based on the basis of the contribution of three different forestry enterprises and the potential value of different forestry enterprises, the corresponding alternative evolution path of the functional ecological evolution of forestry

enterprises in the northeast state-owned forest sector is proposed.

Keywords: Ecological niche, situation & potential, compound weight, evolutionary path.

1. Introduction

Northeast State-owned forest area is an important resource producing area and natural ecological levee in China. It has been shouldering the responsibility of national timber production and has made an important contribution to the national economic construction. Northeast state-owned forest industry group has long been taking timber harvesting as its main production and management task. However, due to the limitation of forest resources endowment and the insufficiency of state-owned forest industry management system, the state-owned forest region in Northeast China has gradually presented economic, resource and environmental crises. Since April 1, 2014, the commercial logging of timber has been completely stopped in the Northeast State-owned Forest Area, and forestry enterprises are facing severe economic development and social problems in the forest area. Based on the theory of niche state and potential, combined with the current situation of the development of forestry enterprises in the Northeast State-owned Forest Region, this paper identifies and evaluates the niche state and potential evaluation indexes of forestry enterprises in the Northeast State-owned Forest Region, and then constructs a path selection matrix model. Analyzes and discusses the path selection of forestry enterprises in order to select the evolution path suitable for the forestry enterprises in the Northeast State-owned Forest Region according to the current state and potential of forestry enterprises.

2. Study on the theory of niche and potential

There are two main viewpoints in Foreign Studies: Harman and Freeman study from the perspective of enterprise population, and they think that the enterprise niche is the multi-dimensional resource space occupied by the enterprise in the strategic environment; Baum and others describe it from the perspective of enterprise monomer, that is, the enterprise niche is the characteristics of the

enterprise in the demand and production capacity of the enterprise monomer, which can show the state of the enterprise. The two views of niche are different in research object and purpose, which can be understood as macro niche and micro niche (Guo and Xu, 2009).

According to the theory of niche state and potential put forward by Zhu (1997), any biological unit in the nature has the attributes of "state" and "potential". "State" refers to the state of biological unit, which is the result of growth, development, learning and interaction with the environment in the past; "Potential" refers to the actual dominance or influence of biological units on the environment, such as the rate of energy and material transformation, the rate of biological growth, and the ability to occupy a new environment. Wan (2004) based on the theory of enterprise niche situation, in order to comprehensively evaluate and analyze the development level of enterprises in all aspects, the dimensions of enterprise niche are subdivided, the weight of factors is distributed, and the comprehensive situation evaluation system of enterprise competitiveness is constructed. According to Xuan (2017), the niche of an enterprise reflects the ability of an enterprise to transform its achievements in the industry competition. By analyzing the competitive strength of the niche of an enterprise and comparing the utilization of internal resources of an enterprise, the competitiveness of an enterprise can be evaluated. A.M. Yan with the help of two dimensions of "state" and "potential", the enterprise evaluation index system from the perspective of enterprise niche is formed. In the dimension of "state", it is subdivided into micro factors such as enterprise scale, social influence level and human resource level. In the dimension of "potential", it is subdivided into "potential" factors, which are expressed by the enterprise's organizational management ability, operation ability, technological innovation ability and marketing ability (Yan, 2006). Based on the establishment of the forest eco-economic performance evaluation index system, Li and Zhao (2019) calculated the forest eco-economic performance level of the key state-owned forest areas in northeast China and identified its obstacle factors, and showed the evolution stage of the forest eco-economic performance level of the key state-owned forest areas in northeast China. Based on the theory of "state" and "potential" of enterprise niche evaluation, Li (2016) constructed the index system of energy enterprise niche evaluation, conducted comprehensive evaluation on the niche of listed coal mining companies, and then clarified the direction of enterprise ecological strategy selection. Zhang (2016) studied the performance of forest resource management from the perspective of ecological niche and proposed corresponding improvement measures. Jiang (2015) uses AHP to build the management performance evaluation index system of forest farm and obtains the current situation of forest farm management through the analysis of the objectives and contents of forest farm management performance evaluation. Liu (2014) used AHP and other methods to establish the evaluation index system of forest resources and evaluated the performance of forest resources management in state-owned forest

farms. Zhang (2014) reviewed the situation of the industrial niche in all stages of the Northeast State-owned Forest Region, identified the ecological niche evolution factors such as resources, demand, technology, policy and system with the situation awareness visualization model, and clarified the synergistic mechanism in the evolution of the forest industrial niche. Geng and Zhang (2014) described the spatial structure and functional structure of the forest industry ecosystem in Heilongjiang state-owned forest area, established the factor model of the forest industry niche, and comprehensively evaluated the evolution power of the forest industry niche in Heilongjiang state-owned forest area. Li (2010) combines the theory of "niche" in ecology with the theory of technology innovation strategy and applies the theory of enterprise niche to solve the problem of technology innovation strategy selection of high-tech enterprises. Shi and Tian (2018) established the evaluation index system of ecological niche situation of green process innovation in home appliance manufacturing industry, proposed the path selection matrix model of green process innovation in home appliance manufacturing industry, and finally determined the path of green process innovation in home appliance manufacturing industry. The empirical results show that compared with the traditional design method of enterprise evaluation model based on financial indicators, this method can comprehensively and systematically reflect the comprehensive situation of the enterprise, and more effectively reflect the survival level and development ability of the enterprise (Haroon *et al.*, 2018; Islam *et al.*, 2020; Suman *et al.*, 2020; Zulkapli *et al.*, 2018).

3. Development status of forestry enterprises in Northeast state-owned forest region

The state-owned forest regions in northeast China include Longjiang forest region, Jilin forest region, Changbai mountain forest region and Daxinganling forest region. With the implementation of the natural forest resources protection project and the prohibition of commercial logging, the benefits of forestry enterprises in the northeast state-owned forest regions have decreased obviously. In the northeast state-owned forest region, forestry enterprises not only have a certain social welfare nature, but also take charge of optimizing the regional ecological environment and developing the economy. According to the data of China forestry statistical yearbook 2017, Heilongjiang statistical yearbook, Jilin statistical yearbook and Heilongjiang forest industry comprehensive statistical data collection, the development status of 87 forestry enterprises in northeast state-owned forest regions in 2017 includes the following aspects:

3.1. Cultivation and protection of forest resources

The average growth rate of plantation area, restoration area, tending area and seedling area of 87 forestry enterprise samples is 26.68%, 30.79%, 16.53% and 81.63%, respectively. All of them are higher than the statistical median, indicating that the overall growth of forest resources cultivation of 87 forestry enterprises is good.

The standard deviation of the growth rate of artificial afforestation is 1.56, with a relatively large degree of dispersion; the standard deviation of the growth rate of the restoration area of degraded forest is 1.14, with a relatively small degree of dispersion; the standard deviation of the growth rate of the tending area of forest is 0.31, with the smallest degree of dispersion, that is, the difference of the growth rate of the tending area of forest between enterprises is relatively small; the standard deviation of the average growth rate of the nursery area is 2.67, with the largest degree of dispersion among several indicators. The results show that there are great differences in the growth of seedling area among different forestry enterprises (Asadullah *et al.*, 2018; Eyankware, 2019; Kamel *et al.*, 2018; Mustafa *et al.*, 2019).

The average growth rate of commodity timber, sawn timber and wood-based panel output of 87 forestry enterprises is - 18.61%, which is seriously lower than the average and all enterprises show zero growth or negative growth, indicating that the production capacity of timber products of forestry enterprises in Northeast State-owned Forest Region is shrinking sharply. Among them, there are 54 enterprises whose output growth rate is higher than the average, accounting for 62.07%, indicating that the distribution of output growth rate of sample enterprises is not uniform. The standard deviation of yield growth rate is 0.24, and the degree of dispersion is relatively small, which indicates that there is little difference in the yield growth of commercial timber, sawn timber and wood-based panel in different forestry.

3.2. The production of main products of forestry enterprises including commodity materials, converted materials and wood-based board

Table 1. Ecological Niche Status and Potential Evaluation Index System of Forestry Enterprises in Northeast State-Owned Forest Regions

The target layer	Criterion layer A	Sub criteria layer B	Index layer C	Unit	
State level	Economic performance A1	Development of forest resources B1	Timber and bamboo picking and transportation C1	Ten thousand yuan	
			Economic forest products C2	Ten thousand yuan	
		Development of non-forest resources B2	Flowers and other ornamental plants C3	Ten thousand yuan	
			Terrestrial wildlife C4	Ten thousand yuan	
			Forest Industry B3	Wood processing and manufacturing C5	Ten thousand yuan
				Furniture manufacturing C6	Ten thousand yuan
		Wooden crafts and stationery C7		Ten thousand yuan	
		Forestry production services and leisure tourism B4	Processing and manufacturing of non-wood forest products C8	Ten thousand yuan	
			Forestry tourism and leisure service C9	Ten thousand yuan	
		Investment in forestry industry B5	Forestry production service C10	Ten thousand yuan	
			Forestry industry development investment C11	Ten thousand yuan	
		Income of employees B6	Per capita wage of on-the-job employees C12	Ten thousand yuan	
	Ecological effect A2	Cultivation of forest resources B7	Tree breeding and seedling raising C13	Ten thousand yuan	
			Afforestation and regeneration C14	Ten thousand yuan	
			Forest management, management and Cultivation C15	Ten thousand yuan	
		Forestry ecological investment B8	Investment in ecological construction and protection C16	Ten thousand yuan	
			Forestry support and guarantee investment C17	Ten thousand yuan	
	Social results A3	Employment and pension B9	Number of employees on duty C18	Person time	
			Number of people who leave the unit and still maintain labor relations C19	Person time	
			Living expenses of retirees C20	Ten thousand yuan	
		Forestry Public Management and services B10	Forestry Public Management and other organizational services C21	Ten thousand yuan	
		Investment in forestry infrastructure B11	Investment in forestry infrastructure construction C22	Ten thousand yuan	

The target layer	Criterion layer A	Sub criteria layer B	Index layer C	Unit
Potential level	Economic performance A4	Production capacity of wood products B12	Growth rate of commercial timber, sawn timber and wood-based panel production C23	%
		Production capacity of non-wood products B13	Growth rate of economic forest products, medicinal materials, fungi and wild vegetables C24	%
			Growth rate of large livestock and poultry C25	%
			Growth rate of forest tourists C26	%
		Income growth ability of employees B14	Per capita wage growth rate of on-the-job employees C27	%
		Investment degree of forestry industry development B15	Proportion of forestry industry development investment in total investment C28	%
		Development degree of output value of non-wood products and tertiary industry B16	Proportion of output value of non-wood products C29	%
			Proportion of output value of tertiary industry C30	%
	Ecological effect A5	Cultivation degree of forest resources B17	Proportion of forest resources cultivation in total output value C31	%
		Growth capacity of forestry ecological investment B18	Growth rate of investment in ecological construction and protection C32	%
			Forestry support and guarantee investment growth rate C33	%
		Degree of ecological investment B19	Proportion of ecological construction and protection investment in total investment C34	%
			Proportion of forestry support and guarantee investment in total investment C35	%
		Cultivation capacity of forest resources B20	Afforestation area growth rate C36	%
			Growth rate of restoration area of degraded forest C37	%
			Growth rate of forest tending area C38	%
Growth rate of seedling area C39	%			
Social results A6	Employment and retirement growth B21	Growth rate of number of employees on duty C40	%	
		Growth rate of number of people leaving the unit C41	%	
		Growth rate of living expenses of retirees C42	%	
	Investment growth capacity of forestry infrastructure B22	Investment growth rate of forestry infrastructure construction C43	%	
	Investment degree of forestry infrastructure construction B23	Proportion of forestry infrastructure construction investment in total investment C44	%	
	Proportion of forestry public management and service B24	Proportion of forestry public management and service in total output value C45	%	

3.3. Production of non-wood products

The average growth rate of plant products including economic forest products, medicinal materials, fungi and wild vegetables was 58.04%. The average growth rate of

livestock and poultry was 70.62%. The average growth rate of the number of forest tourists (person-time) was 172.05%, which was much higher than the median value of 2.25%, -5.13% and 12.9%, indicating that 87 forestry

enterprises had a strong ability to improve the production of non-wood products.

The standard deviation of growth rate of economic forest products, medicinal materials, fungi and wild vegetable products is 2.6, and the dispersion degree is relatively the smallest among several indicators, indicating that the production capacity difference of different forestry enterprises in this respect is relatively the smallest. The standard deviation of the growth rate of livestock and poultry was 5.16, indicating a relatively large dispersion degree. The standard deviation of the growth rate of the number of forest tourists (person-times) is as high as 6.24, and the dispersion degree is the largest among several indicators, indicating that there is a big difference in the development of forest tourism in the enterprise samples.

3.4. Employees and labor remuneration

The average growth rate of the number of employees on the job was -4.66%, and the average growth rate was lower than the median -3.76%, indicating that the overall size of employees in forestry enterprises was shrinking. The average growth rate of the number of people who leave the unit and still retain labor relations is as high as 64.16%, slightly higher than the median value of 58.51%. The average growth rate of per capita wage of on-the-job employees was 9.02%, slightly higher than the median value of 8.03%, indicating that the overall growth rate of per capita wage of forestry enterprises was slightly better. The growth rate of living expenses for retirees was only 1.12 percent, much lower than the median of 8.25 percent, indicating that the living expenses of retirees in forestry enterprises were gradually relieved.

The standard deviation of the growth rate of the number of on-the-job employees was 0.11, the smallest dispersion degree among several indicators, indicating that there was little difference in the growth rate of the number of on-the-job employees of various forestry enterprises. The standard deviation of both the growth rate of labor relations and the growth rate of wages per worker are 0.16, with a relatively larger dispersion degree. The standard deviation of the growth rate of living expenses of retirees is 0.36, which is the largest discrete degree among several indicators, indicating that the difference degree of the change of living expenses of retirees in different forestry enterprises is relatively higher.

3.5. Forestry investment completion

The investment in ecological construction and protection accounted for 87.33% of the total investment, which was basically consistent with the median of 88.67%. The average proportion of the investment in the development of forestry industry in the total investment is 2.99%, slightly higher than the median. The average proportion of forestry support and guarantee investment in the total amount of completed investment was 1.6%, slightly higher than the median value of 0.49%. Investment in forestry infrastructure construction accounted for 8.07% of the total amount of total investment, slightly higher than the median 6.7%, indicating that different forestry enterprises have relatively balanced forestry investment.

3.6. Output value of forestry enterprises

The primary industry of 87 forestry enterprises accounted for 45.49% of the total output value on average, among which the output value of wood products of the primary industry accounted for 19.83%, and the output value of non-wood products accounted for 26.11%. The average proportion of the secondary industry in the total output value was 17.36%. The average proportion of the tertiary industry in the total output value is 36.7%, indicating that the output value of the secondary industry of forestry enterprises has decreased while the output value of the tertiary industry and non-wood products is gradually increasing.

4. Design of state and potential evaluation index system

4.1. Evaluation index system of ecological status and potential of forestry enterprises in Northeast state-owned forest region

According to the view of ecology, niche includes two basic levels, state and potential, which are interrelated. "state" refers to the state of individual accumulation and occupation of resources. "Potential" is an individual's ability to change and adapt to the environment. The "state" of forestry enterprises in northeast state-owned forest region refers to the original accumulation of forestry enterprises. "Potential" refers to the dominant ability of forestry enterprises to influence the environment. Based on the existing domestic and foreign literatures, this study establishes the niche evaluation index system of forestry enterprises in northeast state-owned forest region from two aspects of niche. According to the evaluation principles of objectivity, practicability, qualitative and quantitative combination, static and dynamic combination, 45 indexes of state and potential attributes were selected to construct the ecological niche and potential evaluation index system of forestry enterprises in northeast state-owned forest regions. Under the two objective levels of state level and potential level, the ecological niche of forestry enterprises in northeast China is evaluated from the three criteria of economic benefit, ecological benefit and social benefit. Under the state forestry enterprise target layer, the economic benefits of rule layer through the forest resources (B1), the development of the forest resources development situation (B2), forest industry (B3), forestry production and leisure travel service (B4), the forestry industry investment situation (B5), the income of employees (B6) six layer is the criterion to measure; The ecological benefit criterion layer is measured by two sub-criteria: forest resource cultivation (B7) and forest ecological investment (B8). Social benefits are measured by three sub-criteria: employment and pension (B9), forestry public management and services (B10), and forestry infrastructure investment (B11).

Under the potential target level of forestry enterprises, economic benefits are measured by five sub-criteria: wood product production capacity (B12), non-wood product production capacity (B13), employee income growth capacity (B14), forestry industry development investment

degree (B15), non-wood product and tertiary industry output value development degree (B16). Ecological benefits were measured by four sub-criteria: forest resources cultivation degree (B17), forestry ecological investment growth ability (B18), ecological investment degree (B19) and forest resources cultivation ability (B20). Social benefits are measured by four sub-criteria:

employment and retirement growth (B21), growth capacity of forestry infrastructure investment (B22), investment degree of forestry infrastructure construction (B23), proportion of forestry public management and services (B24). C1-C45 quantifiable indicators were selected under each sub-criterion of state and potential, as shown in Table 1.

Table 2. Objective Weight of Index Obtained by Entropy Weight Method

	C1	C2	C3	C4	C5	C6	C7	C8
Index weight at state level W_{ei}	0.027	0.051	0.008	0.031	0.044	0.017	0.031	0.027
	C9	C10	C11	C12	C13	C14	C15	C16
	0.045	0.048	0.024	0.072	0.042	0.047	0.078	0.061
	C17	C18	C19	C20	C21	C22		
	0.055	0.059	0.074	0.059	0.046	0.056		
Index weight at potential level w_{ei}	C23	C24	C25	C26	C27	C28	C29	C30
	0.049	0.036	0.035	0.038	0.066	0.040	0.045	0.048
	C31	C32	C33	C34	C35	C36	C37	C38
	0.046	0.041	0.034	0.052	0.044	0.039	0.040	0.042
	C39	C40	C41	C42	C43	C44	C45	
	0.039	0.046	0.050	0.053	0.033	0.045	0.043	

Table 3. Subjective Weight of Indicators Obtained by AHP

	C01	C02	C03	C04	C05	C06	C07	C08
Index weight at state level W_{ai}	0.040	0.043	0.008	0.019	0.017	0.011	0.013	0.035
	C09	C10	C11	C12	C13	C14	C15	C16
	0.014	0.003	0.021	0.073	0.059	0.107	0.194	0.060
	C17	C18	C19	C20	C21	C22		
	0.120	0.016	0.004	0.006	0.041	0.097		
Index weight at potential level W_{ai}	C23	C24	C25	C26	C27	C28	C29	C30
	0.119	0.023	0.005	0.013	0.063	0.057	0.006	0.012
	C31	C32	C33	C34	C35	C36	C37	C38
	0.069	0.086	0.172	0.050	0.025	0.055	0.038	0.023
	C39	C40	C41	C42	C43	C44	C45	
	0.023	0.024	0.005	0.009	0.016	0.077	0.032	

4.2. Data sources and standardized processing

In order to comprehensively, truly and accurately reflect the ecological niche of forestry enterprises in the Northeast State-owned Forest Area, the data used in the analysis are all from the statistical data such as China forestry statistical yearbook, Heilongjiang statistical yearbook, Jilin statistical yearbook and Heilongjiang forest industry comprehensive statistical data collection between 2016 and 2017. The Z-score method is used for standardization, which divides the result of subtracting the single number from the mean value of the set by the standard deviation of the set to get the standardized result. This method is similar to the standardized transformation of normal distribution, and the transformation function is as follows:

$$Z = \frac{(x - \mu)}{\sigma} \tag{1}$$

Z is the standard value, x is the original value that needs to be standardized, μ is the mean, σ is the standard deviation, and $\sigma \neq 0$. Most of the 45 indicators are positive indicators, but C19 and C41, which reflect social benefits, are obviously reverse indicators. Therefore, it is necessary to

use the formula of range transformation method to process the reverse indicators.

$$A_{ij} = \frac{\max(Z_{ij}) - Z_{ij}}{\max(Z_{ij}) - \min(Z_{ij})} \tag{2}$$

A_{ij} is the inverse index positive value, Z_{ij} is the enterprise index standardized value, $\max(Z_{ij})$ and $\min(Z_{ij})$ respectively represent the maximum and minimum value of i indicators.

5. Obtaining composite weight set of evaluation index

5.1. Obtaining objective weight of evaluation index by entropy weight method

Firstly, the entropy weight coefficient method is adopted to calculate the objective weight of each index. It needs a certain amount of sample data to support, and the calculation process is relatively simple and the analysis principle is intuitive. First, calculate the entropy value according to the standardized data:

$$e_i = \frac{\sum_{j=1}^n x_{ij} \ln x_{ij}}{\ln n} \tag{3}$$

e_i is the entropy value of the i th initial evaluation index x_{ij} . If the entropy value of an index is smaller, it means that the

variation degree of its index value is larger, the information provided is larger, and it plays a bigger role in the evaluation, so its weight is also larger. Otherwise, the weight is smaller. Finally, the results of calculating the index entropy weight are shown in Table 2.

$$w_i = \frac{1 - e_i}{\sum_{i=1}^n (1 - e_i)} \tag{4}$$

where, w_i is the entropy weight of x_{ij} , $0 \leq w_i \leq 1$ and $\sum_{i=1}^n w_i = 1$.

5.2. The subjective weight of evaluation index is obtained by AHP

5.2.1. Construct judgment matrix

Through the analysis of the system, the evaluation index system of hierarchical structure is constructed. According to the evaluation criteria of the upper layer, the relative importance of two indicators in the lower layer is compared, and the judgment matrix is established. The judgment matrix of ecological niche AHP to obtain the subjective weight of the index was constructed by consulting forest-related experts and professors with the method of 9 proportional scale.

W_T represents the judgment matrix of A1, A2 and A3 indexes relative to the target level of the state level, while W_S represents the judgment matrix of A4, A5 and A6 indexes relative to the target level of the potential level. W_{B1} represents the judgment matrix of indicators B1, B2, B3, B4, B5 and B6 relative to superior indicator A1...; W_{C1} represents the judgment matrix of C1, C2 and C3 indicators relative to their superior indicator B1.

Table 4. Obtaining Composite Weight of Evaluation Index by Minimum Entropy Principle

	C01	C02	C03	C04	C05	C06	C07	C08
Index weight at state level w_i	0.036	0.052	0.009	0.027	0.031	0.015	0.022	0.034
	C09	C10	C11	C12	C13	C14	C15	C16
	0.027	0.013	0.024	0.081	0.055	0.079	0.136	0.067
	C17	C18	C19	C20	C21	C22		
	0.090	0.034	0.018	0.021	0.048	0.082		
Index weight at potential level w_i	C23	C24	C25	C26	C27	C28	C29	C30
	0.084	0.032	0.014	0.024	0.071	0.053	0.018	0.026
	C31	C32	C33	C34	C35	C36	C37	C38
	0.062	0.066	0.085	0.056	0.036	0.051	0.044	0.034
	C39	C40	C41	C42	C43	C44	C45	
	0.033	0.037	0.018	0.024	0.025	0.065	0.041	

Table 5. List of Niche Values of Forestry Enterprises in Northeast State-Owned Forest Region

Aershan	Zuoer	Chuoyuan	Wuerqihan	Kuduer	Tulihe	Yitulihe	Keyihe
3.42	3.59	3.31	3.56	3.64	3.54	3.36	3.45
Ganhe	Jiwen	Alihe	Genhe	Jinhe	Alongshan	Mangui	Deerbuer
3.59	3.45	3.59	4.08	3.58	3.49	3.66	3.53
Moerdaoga	Dayangshu	Bilahe	Linjiang	Sanchazi	Wangou	Songjianghe	Quanyang
3.91	3.22	3.21	4.48	4.36	3.48	3.53	3.37
Lushuihe	Baishishan	Hongshi	Huangnihe	Dunhua	Dashitou	Bajiazi	Helong
3.55	3.65	3.70	3.40	3.89	3.65	3.63	3.91
Wangqing	Daxinggou	Tianqiaoling	Baihe	Hunchun	Dahailin	Chaihe	Dongjingcheng
3.74	3.34	3.39	4.41	3.74	3.59	3.82	3.81
Muling	Suiyang	Hailin	Linkou	Bamiantong	Huanan	Shuangyashan	Heli
3.89	4.37	3.69	3.78	3.37	3.34	3.08	3.17
Hebei	Dongfanghong	Yingchun	Qinghe	Shuangfeng	Tieli	Taoshan	Langxiang
3.46	3.97	3.28	3.69	3.21	3.65	3.45	3.49
Nancha	Jinshantun	Meixi	Wumahe	Cuiluan	Youhao	Shangganling	Wuying
3.47	3.31	3.69	3.38	3.36	3.73	3.29	3.81
Hongxing	Xinqing	Tangwanghe	Wuyiling	Shanhetun	Weihe	Yabuli	Fangzheng
3.23	3.69	3.54	3.20	3.68	3.65	3.78	3.74
Xinglong	Suiling	Tongbei	Zhanhe	Dailing	Songling	Xinlin	Tahe
3.44	3.50	3.34	4.05	3.63	4.07	4.31	4.32
Huzhong	Amuer	Tuqiang	Xilinji	Shibazhan	Hanjiayuan	Jiagedaqi	
4.08	3.78	3.74	4.05	3.57	4.06	3.88	

5.2.2. Weight calculation

Find the maximum eigenvalue λ_{max} of the judgment matrix, and the corresponding eigenvector is W (w_1, w_2, \dots, w_m),

classified the importance of the judgment of the previous layer, and obtained the weight value of the feature vector w .

5.2.3. Conformance test

Due to the complexity and randomness of the system, the judgment matrix of the expert consulting method may not be consistent, and the judgment matrix must be tested to maintain consistency. The test formula is:

$$CR = \frac{CI}{RI} = \frac{\lambda_{max} - m}{(m - 1)RI} \tag{5}$$

In the formula, *CI* represents the consistency index, *m* is the order, *CR* is the random consistency ratio, and the judgment matrix *CR* is all less than 0.1, indicating that the weight is reasonable and the consistency is good. The final subjective weight of the evaluation index is shown in Table 3.

5.3. Obtaining composite weight of evaluation index by minimum entropy principle

In the process of comprehensive evaluation, the value of index weight will affect the rationality of the evaluation

Table 6. List of Ecological Potential Value of Forestry Enterprises in Northeast State-Owned Forest Region

Aershan	Zuoer	Chuoyuan	Wuerqihan	Kuduer	Tulihe	Yitulihe	Keyihe
6.49	6.35	6.27	6.22	6.30	6.42	6.27	6.64
Ganhe	Jiwen	Alihe	Genhe	Jinhe	Alongshan	Mangui	Deerbuer
6.24	6.37	6.20	6.32	6.50	6.33	6.31	6.23
Moerdaoga	Dayangshu	Bilahe	Linjiang	Sanchazi	Wangou	Songjianghe	Quanyang
6.35	6.33	6.44	6.39	6.11	6.09	6.12	6.32
Lushuihe	Baishishan	Hongshi	Huangnihe	Dunhua	Dashitou	Bajiazi	Helong
6.13	6.25	6.28	6.19	6.17	6.51	6.41	6.60
Wangqing	Daxinggou	Tianqiaoling	Baihe	Hunchun	Dahailin	Chaihe	Dongjingcheng
6.79	6.37	6.18	7.44	6.40	5.94	6.11	6.28
Muling	Suiyang	Hailin	Linkou	Bamiantong	Huanan	Shuangyashan	Heli
5.92	6.06	5.95	6.30	6.40	5.98	5.95	6.06
Hebei	Dongfanghong	Yingchun	Qinghe	Shuangfeng	Tieli	Taoshan	Langxiang
5.83	5.97	6.00	5.95	5.92	6.13	5.99	5.79
Nancha	Jinshantun	Meixi	Wumahe	Cuiluan	Youhao	Shangganling	Wuying
6.07	6.19	6.06	5.86	5.86	5.83	6.33	6.27
Hongxing	Xinqing	Tangwanghe	Wuyiling	Shanhetun	Weihe	Yabuli	Fangzheng
5.58	6.06	5.89	6.08	6.27	6.10	6.07	6.06
Xinglong	Suiling	Tongbei	Zhanhe	Dailing	Songling	Xinlin	Tahe
5.91	6.05	6.07	5.99	5.97	6.29	6.33	6.27
Huzhong	Amuer	Tuqiang	Xilinji	Shibazhan	Hanjia yuan	Jiageda qi	
6.32	6.23	6.36	6.15	6.31	6.35	6.36	

5.4. Evaluation results of ecological position and potential of forestry enterprises in Northeast State-owned Forest region

In order to quantitatively calculate the niche status and potential level of forestry enterprises in the northeast state-owned forest region, it is necessary to conduct standardized processing on the index data. Through formula (7) and formula (8), the comprehensive evaluation value of ecological niche level and potential level indexes of different forestry enterprises can be obtained, namely the *os* and *op* values of each forestry enterprise.

$$os_j = \sum_{i=1}^{22} w_i \times A_{ij} \tag{7}$$

The objective weight of entropy weight assignment reflects the difference between the measured values of each index. AHP is used to calculate the subjective weight of indicators to reflect the relative importance of each indicator. Therefore, by integrating subjective weight and objective weight, the minimum entropy principle can obtain the composite weight of evaluation index.

$$w_i = \frac{\sqrt{w_{ei} \times w_{oi}}}{\sum_{i=1}^n \sqrt{w_{ei} \times w_{oi}}} \tag{6}$$

In the formula, *w_i* is compound weight, *w_{ei}* and *w_{oi}* are objective weight and subjective weight respectively, and *n* is the number of indicators in the evaluation sample. The Lagrange multiplier method is used to optimize the composite weight, and the final composite weight of the evaluation index is obtained as shown in Table 4.

$$op_j = \sum_{i=23}^{45} w_i \times A_{ij} \tag{8}$$

In the formula, *os_j* represents the ecological niche value of the *j*th enterprise, *op_j* represents the ecological potential value of the *j*th enterprise, *w_i* is the compound weight, and *A_{ij}* is the standardized value of the *j*th item of the *i*th enterprise. The final ecological niche value calculation results of each forestry enterprise are shown in Table 5, and the ecological niche value calculation results are shown in Table 6.

6. Evolution path selection

6.1. Construction of niche evolution path selection matrix model for forestry enterprises

Based on the above for the northeast forestry enterprises of state-owned forest ecological niche, the analysis on the level of potential, according to the different forestry enterprise niche and potential evaluation result, constructs the northeast state-owned forest ecological niche evolution route choice matrix model, and make the different forestry enterprises according to their own niche status, choose suitable evolution path, as shown in Figure 1.

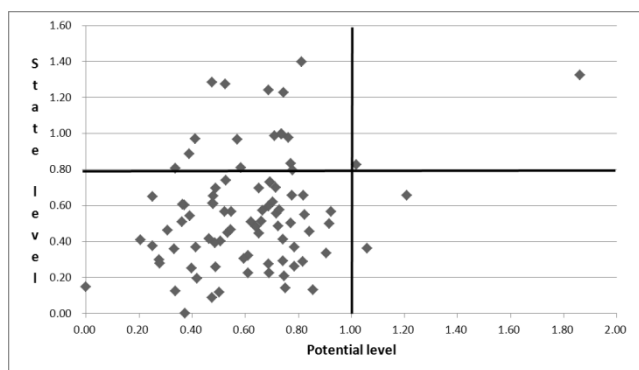


Figure 1. Matrix model of niche evolution path selection for forestry enterprises in northeast state-owned forest region

The vertical axis of Figure 1 shows the evaluation value of niche status of forestry enterprises in the northeast state-owned forest region, that is, the power of resource possession under certain conditions. The horizontal axis shows the evaluation value of ecological potential, indicating the actual influence and dominant position of enterprises on the surrounding environment under certain conditions. When the evaluation value is 0, the ability is the lowest. Along with the improvement of the evaluation value of the horizontal and vertical coordinate, it indicates that the forestry enterprise's ability of resource occupation and environmental control and utilization is enhanced. The 87 scatter points in Figure 1 respectively represent the niche status and potential position of 87 forestry enterprises in the northeast state-owned forest region. In order to enhance the scatter visual effect, the data of the scatter diagram is translated, with the horizontal axis being translated by 5.58 to the left and the vertical axis being translated by 3.08 to the down.

6.2. The selection mode of niche evolution path of forestry enterprises in Northeast state-owned forest region

6.2.1. Niche path dependence and path breakthrough evolution of forestry enterprises

Niche path dependence of forestry enterprises refers to the path locked in existing resources, needs, technologies, policies and systems due to accidental or random events in the early development of forestry enterprises, and the locked path may be positive or negative. The positive path-dependent effect can form the continuous growth of forestry enterprise niche, and the intensified effect of

resources and technology can promote the sustainable development of forestry enterprise niche. As shown in Figure 1, the accumulation of resources, technologies, markets, capital and other conventions formed over A long period of time has played A beneficial role in promoting the forestry enterprises with high state values in area A and area B, forming A virtuous circle. The path dependence effect with negative feedback forms irreversibility, and its evolution direction continues to develop towards deeper and lower efficiency, entering a vicious circle. State as shown in Figure 1C and D area value lower forestry enterprises, in the early stages of state-owned forestry enterprise development, excessive use of forest resources, forest product demand of single and forestry industrial policy and the lack of market mechanism, and makes some forestry enterprise niche evolution locking traditional forestry development path, as the primitive accumulation of resources reduce the formation of the low efficiency of path dependence effect. However, path breakthrough evolution is the creative destruction of the original path through conscious transformation or external forces and the establishment of a new evolutionary path to eliminate negative feedback mechanism.

6.2.2. Passive adaptation and active adaptation evolution of forest enterprise niche

The production and management of forestry enterprises is a process of dynamic adaptation and passive adaptation, including two-way adaptation to the environment and transformation. Any production and operation activities of forestry enterprises should passively accept the natural selection of environment and formulate the adaptive strategy in line with the environment of forestry enterprises. Active adaptation is the biggest difference between niche evolution and natural niche evolution of forestry enterprises. In the process of active adaptation evolution, forestry enterprises continue to enhance their ability to transform the industrial environment and enhance their active adaptability to the industrial environment. The evolution of forest enterprise niche initiative adaptation is reflected in the ability of enterprise to improve individual change and adapt to the environment, such as the rate of energy and material exchange, growth rate, economic growth rate, etc. As shown in Figure 1, the potential values of zone B and Zone D are low, indicating that the ability of enterprises in the region to transform and adapt to the environment is low, while the potential values of zone a and Zone C are high, indicating that these forestry enterprises have certain influence on the current and future environment. The evolution of forestry enterprises' initiative adaptation plays a decisive role in the future development direction of enterprises.

Combined with the functional ecological selection of forestry enterprises in the Northeast State-owned Forest Region, it has three advantages: economic interest priority, ecological interest priority and ecological niche of forestry enterprises. Based on the contribution degree of three benefit States and potential values of different forestry

enterprises, the paper puts forward the corresponding alternative evolution path for the functional niche evolution of forestry enterprises in the Northeast State-owned Forest Region.

6.3. Description of each region of selection matrix model and case analysis of forestry enterprises

The selection matrix model is equally divided into four quadrants, and according to different states and potential positions, the idea of choosing the evolutionary path of forestry enterprises in northeast state-owned forest region is put forward.

6.3.1. Ecological niche status and potential evaluation are in area A

There are only two forestry enterprises in area a, accounting for only 2.3%. Area a shows that the forestry enterprises are in the excellent state of "state" and "potential", and the enterprises have reached a higher capacity in the environment conducive to their own development. Therefore, the forestry enterprises in this area are the best ecological niche, and the locked path has a positive impact on the enterprises. In the long-term development of production and management, forestry enterprises have accumulated certain capacity in all aspects. In the further development, forestry enterprises should analyze and integrate the existing resources to realize the coordinated realization of economic benefits, ecological benefits and social benefits.

Taking Baihe as an example, the state and potential values of the enterprise are relatively high (1.32 and 1.86, respectively), indicating that the locked path dependence is conducive to better matching of resources and capabilities. The economic benefit, ecological benefit and social benefit of the state value are 0.46, 0.56 and 0.3. The three benefits of potential value are 0.51, 0.98 and 0.37 respectively. It can be seen that the ecological benefits of Baihe are the most advantageous in terms of state and potential. So the "path dependence - priority of ecological benefits" niche evolution is the appropriate choice of Baihe niche evolution.

6.3.2. Ecological niche status and potential evaluation are in area B

There are 14 forestry enterprises with evaluation value in area B, accounting for 16.1%. The forestry industry environment has a certain positive impact on these forestry enterprises. The environment and resources can promote the good development of enterprises. Enterprises have rich resources in a broader ecological niche environment. However, the limited potential of forestry enterprises shows the weak development ability and the low level of control and control over the environment.

Taking Xinlin as an example, the higher state value and the lower potential value of enterprises are 1.23 and 0.74 respectively, which indicates that enterprises have good original accumulation but general control ability. Therefore, they should establish their own characteristics, actively enhance their ability to adapt and transform the environment and form a competitive advantage. The

economic benefit, ecological benefit and social benefit of state value are 0.42, 0.56, 0.25; the three benefits of potential value are 0.24, 0.35, 0.15, respectively. It can be seen that Xinlin has great advantages in the development of ecological benefit in state and potential. Therefore, the niche evolution of "initiative adaptation - ecological benefit priority" is a reasonable choice for Xinlin niche evolution.

6.3.3. Ecological niche status and potential evaluation are in area C

There are two forestry enterprises in area C, accounting for only 2.3%. These enterprises occupy a narrow niche, occupy relatively less resources, and threaten the development of enterprises. But at the same time, the enterprise has high potential. At this time, the enterprise should break away from the environmental constraints as soon as possible, actively expand the potential niche, and break through the current negative feedback path dependence.

Taking Wangqing as an example, the low state value and high potential value of the enterprise are 0.66 and 1.21 respectively, indicating that the enterprise has strong capability but worrying resources and environment, so it should actively explore the potential ecological niche. The score of economic benefit, ecological benefit and social benefit is 0.24, 0.27 and 0.15. The three major benefits of potential value are 0.41, 0.55 and 0.24, respectively. It can be seen that the development advantages of ecological benefits in the state and potential of Wangqing are relatively large. So "path breakthrough - ecological benefit priority" niche evolution is + + niche evolution appropriate choice.

6.3.4. Ecological niche status and potential evaluation are in area D

There are 69 forestry enterprises in the D region, accounting for 79.34% of the total, accounting for the majority of state-owned forestry enterprises in Northeast China. The potential of forestry enterprises in this position is not only small, but also the environment is very unfavorable to them. Therefore, on the one hand, forestry enterprises should get rid of the original path lock, break the negative cycle to achieve path breakthrough, on the other hand, they need to strengthen their ability to adapt to the environment and transform the environment.

Taking Wumahe as an example, the enterprise state value and potential value are relatively low, 0.3 and 0.28 respectively, indicating that the enterprise capacity and environmental resources are poor. The economic benefit, ecological benefit and social benefit of state value are 0.11, 0.12, 0.06; the three benefits of potential value are 0.09, 0.13, 0.06, respectively. It can be seen that the development advantage of state and potential ecological benefit of Wumahe is relatively large. Therefore, "path breakthrough initiative adaptation ecological benefit priority" niche evolution is a more reasonable choice for Wumahe niche evolution at present.

7. Conclusion

On the basis of niche theory, a niche status and potential evaluation index system for forestry enterprises in northeast state-owned forest region was established, and the niche status and potential values of 87 forest enterprise samples in northeast state-owned forest region were calculated by using entropy method, analytic hierarchy process and compound weighting method. On the basis of constructing the matrix model of evolution path selection, the feasible evolution path is established for the corresponding forestry enterprises according to different quadrants. It is expected to provide qualitative and quantitative support for the study of niche evolution path of forestry enterprises in northeast state-owned forest regions, so as to promote the development of forestry enterprises and play a positive role in guiding the strategic positioning and operation of forestry enterprises in northeast state-owned forest regions.

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