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Construction of Evaluation System for High-quality Development of Characteristic Towns from the Perspective of Production-Living-Ecology Integration

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Abstract From the perspective of production-living-ecology integration, an evaluation system, involving production quality, living quality and ecological quality, was constructed in this article for high-quality development of characteristic towns. Using Delphi method and analytic hierarchy process, the indices selected based on experience were screened, and the evaluation indices retained were weighted. What's more, relevant suggestions for high-quality development of characteristic towns were put forward from the three aspects of production, living and ecology.

Key words Production-living-ecology integration, Characteristic town, High-quality development, Evaluation index

1 Introduction

In 2016, the construction of characteristic towns in Zhejiang Province aroused widespread attention and positive responses across China. The Party Central Committee and the State Council also attached great importance to it. The National Development and Reform Commission and other departments have successively issued and implemented a series of documents to promote the top-level design of characteristic towns, and China has set off an upsurge of building characteristic towns. In 2017, the "China Characteristic Town Development Forum & Characteristic Town Industry Selection and Operation Model Seminar" emphasized that the construction of characteristic towns requires the integrated development of production, living and ecology. It can be seen that the integration of production, living and ecology not only guides the development of large-scale spaces such as countries and cities, but also has important reference value for the development of small towns in small and medium-sized spaces^[1]. Currently, in the process of constructing characteristic towns, good and bad are intermingled, and establishing a complete evaluation index system and implementing a dynamic evaluation mechanism to promote the survival of the fittest in characteristic towns has become a key link in the current high-quality development of characteristic towns.

2 Concept of production-living-ecology integration^[2] and construction of characteristic towns

Production space is a spatial area closely related to the industrial structure, and its leading function is to provide industrial products, agricultural products and service products. Living space is a space area related to carrying and guaranteeing human settlements. Its leading function is to provide human habitation, consumption, leisure and entertainment. The main function of the space area related to ecology and nature is to provide ecological products and ecological services. The "China Characteristic Town Development Forum & Characteristic Town Industry Selection and Operation Model Seminar 2017" emphasized the integrated development of production, living and ecological space. As a result, the concept of production-living-ecology integration began to play an important guiding role in the structural layout, functional integration, and quality evaluation of small and medium-sized spaces such as characteristic towns. Characteristic town should be a model of production-living-ecology integration. It must have a characteristic industry orientation, as well as residential life function. At the same time, it should set higher requirements for the ecological environment, with industry as the core, integrate production, living and ecology, optimize the ecological environment, attract residents to live in, lead continuous consumption, achieve high-quality and coordinated development, and avoid the old roads of industrial parks and economic development zones. The construction of characteristic towns under the concept of production-living-ecology integration, as a sustainable and innovative industrial organization form, objectively realizes the integration of production function, living function and ecological function and complementation of production space, living space and ecological space. In essence, it is a new development concept^[3].

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3 Construction of evaluation system for high-quality development of characteristic towns from perspective of production-living-ecology integration

3.1 Principles of system construction The construction of index system should follow the three principles of universality and particularity, feasibility and operability, and combination of quantitative and qualitative indices. The indices include both common indices for high-quality economic development and personality indices in line with the concept of production-living-ecology integration^[4-7]. At the same time, the data of statistical indices must be

available, and the quantitative indices and qualitative indices need to combine and complement each other, in order to make the evaluation results more comprehensive and scientific.

3.2 Pre-selection of indices based on experience On the basis of checking related literature and policy documents and in-depth interviews with experts, an evaluation system, with high-quality development of characteristic towns as object level and production quality, living quality and ecological quality as criterion level, was constructed following the above-mentioned principles^[8-10]. For each dimension, plan-level indices were constructed (Table 1).

Table 1 Overall idea of evaluation system for high-quality development of characteristic towns under perspective of production-living-ecology integration

| Level | Purpose and content | Number of items |
|-----------|---|-----------------|
| Object | Comprehensively expressing the high-quality development level of characteristic towns under the perspective of production-living-ecology integration | 1 |
| Criterion | High-quality development of characteristic towns involved in the object layer is divided into three dimensions: production quality, living quality and ecological quality | 3 |
| Plan | The three dimensions of the criterion level are further subdivided to specifically express the evaluation indices under each dimension of the criterion level | 25 |

3.2.1 Production quality index (A). Characteristic industry is the foothold of characteristic town construction. It is also an important factor in determining the development level of characteristic towns. The indices of production quality pre-selected based on experience include 8 aspects: A_1 : GDP per capita (10 000 yuan/person); A_2 : per capita disposable income (yuan/person); A_3 : proportion of per capita disposable income in GDP (%); A_4 : characteristic industry investment (10 000 yuan); A_5 : proportion of the operating income of characteristic industries in the operating income of the town (%); A_6 : GDP energy consumption reduction rate (%); A_7 : industrial chain competitiveness level (points); and A_8 : talent attraction policy.

3.2.2 Living quality index (B). Livable and enterprise-adaptable living space is the home of characteristic town construction.

It is an area closely related to town residents. The indices for quality of living pre-selected based on experience include 9 aspects: B_1 : number of public buses owned (vehicles/10 000 people); B_2 : public WIFI coverage (%); B_3 : public library collections (books/100 people); B_4 : hospital beds owned by per 1 000 people (beds/1 000 people); B_5 : proportion of people's livelihood expenditure in fiscal expenditure (%); B_6 : per capita living area (m^2); B_7 : township noise compliance rate (%); B_8 : residents' happiness index (points); and B_9 : unemployment rate of town residents (%).

3.2.3 Ecological quality index (C). The beautiful ecological space is the guarantee for the development of characteristic industries and the construction of livable and enterprise-adaptable living spaces. Pre-selected indices of ecological quality include 8 aspects: C_1 : energy consumption per unit GDP (ton of standard coal/10 000 yuan); C_2 : proportion of environmental protection expenditure in fiscal expenditure (%); C_3 : per capita area of ecological vegetation (m^2 /person); C_4 : harmless treatment rate of urban domestic garbage (%); C_5 : urban sewage treatment rate (%); C_6 : ambient air compliance rate (%); C_7 : sulfur dioxide

emissions (10 000 t/year); and C_8 : smoke (powder) emissions (10 000 t/year).

3.3 Screening of indices The Questionnaire for Evaluation Indices of High-quality Development of Characteristic Towns under the Perspective of Production-living-ecology Integration was designed. The plan level of the 25 pre-selected indices was designed to three options: "agree", "disagree" and "modify" (with detailed instructions). The evaluation indices pre-selected were screened by experts, and specific suggestions were proposed. When 21 (70%) or more experts agreed, the index was retained; otherwise, it was discarded.

3.3.1 Results and analysis of expert survey on pre-selected production quality indices based on experience. The design of production quality indices had been recognized by experts as a whole. As per capita disposable income and proportion of per capita disposable income in GDP overlapped with each other in content and proportion of per capita disposable income in GDP could better reflect the quality of production, the index of per capita disposable income was discarded, and the index of proportion of per capita disposable income in GDP was retained.

The results of expert survey on production quality indices pre-selected based on experience are shown in Table 2.

3.3.2 Results and analysis of expert survey on pre-selected living quality indices based on experience. The living quality indices were adjusted more based on the results of the expert survey (Table 3). There are two main reasons. On the one hand, characteristic towns are not administrative regions in the general sense, so statistics on basic transportation, finance, and people's livelihood are difficult to realize. The indices of number of public buses owned and proportion of people's livelihood expenditure in fiscal expenditure were revised as qualitative indices. The indices of public transportation convenience, reasonable sharing of public resources and unemployment rate of town residents were discarded. On the other hand, the indices were adjusted due to weak evalua-

tion significance. The indices of public library collections and per capita living area were revised to per capita construction area of

public cultural facilities and proportion of residential land area in construction land area.

Table 2 Results and analysis of expert survey on production quality indices pre-selected based on experience

| Item | Passing rate//% | Process result | Main opinion |
|--|-----------------|----------------|---|
| Per capita GDP (A_1)//10 000 yuan/person | 100 | | |
| Per capita disposable income (A_2)//yuan/person | 20 | Discard | A_2 and A_3 overlap with each other |
| Proportion of per capita disposable income in GDP (A_3)//% | 87 | | |
| Investment in characteristic industries (A_4)//10 000 yuan | 94 | | |
| Proportion of operating income of characteristic industries in operating income of town (A_5)//% | 100 | | |
| Reduction rate of GDP energy consumption (A_6)//% | 100 | | |
| Competitiveness of industrial chain (A_7)//points | 100 | | |
| Talent attraction policy (A_8) | 100 | | |

Table 3 Results and analysis of expert survey on living quality indices pre-selected based on experience

| Item | Passing rate//% | Process result | Main opinion |
|--|-----------------|----------------|--|
| Number of public buses owned (B_1)//vehicles/10 000 people | 40 | Modify | Difficult to count, amended to "public transportation convenience (points)" |
| Public WIFI coverage (B_2)//% | 100 | | |
| Public library collections (B_3)//books/100 people | 50 | Modify | Evaluation significance not strong, amended to "per capita construction area of public cultural facilities (m^2 /person)" |
| Hospital beds (B_4)//beds/1 000 people | 100 | | |
| Proportion of people's livelihood expenditure to fiscal expenditure (B_5)//% | 40 | Modify | Difficult to count, amended to "reasonable sharing of public resources (points)" |
| Per capita living area (B_6)// m^2 | 30 | Modify | Evaluation significance not strong, amended to "proportion of residential land area in construction land area (%)" |
| Noise compliance rate in township (B_7)//% | 97 | | |
| Resident happiness index (B_8)//points | 100 | | |
| Unemployment rate of town residents (B_9)//% | 30 | Disagree | Difficult to count, discarded |

3.3.3 Results and analysis of expert survey on pre-selected ecological quality indices based on experience. The design of production quality indices had been recognized by experts as a whole. The experts believed that characteristic towns currently give priority to the development of new industries, such as high-tech industries, financial industries, cultural and creative industries, and cultural tourism industries, and their environmental quality is relatively good, and the pollution is less. Therefore, the evaluation significance of the two indices of sulfur dioxide emissions and

smoke (powder) emissions is not strong, and they were recommended to be discarded.

The results of expert survey on ecological quality indices pre-selected based on experience are shown in Table 4.

Based on the survey results of the experts, through further analysis, an evaluation system for high-quality development of characteristic towns under the perspective of production-living-ecology integration was constructed (Table 5). The types of indices and data acquisition methods are marked.

Table 4 Results and analysis of expert survey on ecological quality indices pre-selected based on experience

| Item | Passing rate//% | Process result | Main opinion |
|---|-----------------|----------------|---|
| Energy consumption per unit GDP (C_1)//tons of standard coal/10 000 yuan | 90 | | |
| Proportion of environmental protection expenditure in fiscal expenditure (C_2)//% | 97 | | |
| Per capita area of ecological vegetation (C_3)// m^2 /person | 100 | | |
| Harmless treatment rate of urban domestic garbage (C_4)//% | 100 | | |
| Urban sewage treatment rate (C_5)//% | 100 | | |
| Ambient air compliance rate (C_6)//% | 100 | | |
| Sulfur dioxide emissions (C_7)//10 000 t/year | 40 | Discard | Evaluation significance not strong, discarded |
| Smoke (powder) emissions (C_8)//10 000 t/year | 40 | Discard | Evaluation significance not strong, discarded |

Table 5 Evaluation system for high-quality development of characteristic towns under perspective of production-living-ecology integration

| Primary index | Secondary index | Tertiary index | Index type | Data acquisition method |
|--|------------------------|---|------------|---------------------------------------|
| High-quality development of characteristic towns (T) | Production quality (A) | Per capita GDP (A_1) //10 000 yuan/person | Positive | Statistical data |
| | | Proportion of per capita disposable income in GDP (A_2) //% | Positive | Processing and calculation |
| | | Investment in characteristic industries (A_3) //10 000 yuan | Positive | Statistical data |
| | | Proportion of operating income of characteristic industries in operating income of town (A_4) //% | Positive | Enterprise reports and statistics |
| | | Reduction rate of GDP energy consumption (A_5) //% | Positive | Statistical data |
| | | Competitiveness of industrial chain (A_6) //points | Positive | Scoring by experts |
| | Living quality (B) | Talent attraction policy (A_7) | Positive | Scoring by experts/enterprises |
| | | Number of public buses owned (B_1) //vehicles/10 000 people | Positive | Scoring by experts/masses |
| | | Public WIFI coverage (B_2) //% | Positive | Statistical data |
| | | Per capita construction area of public cultural facilities (B_3) //m ² /person | Positive | Statistical data |
| | | Hospital beds (B_4) //beds/1 000 people | Positive | Statistical data |
| | | Reasonable sharing of public resources (B_5) //points | Positive | Scoring by experts/enterprises/masses |
| | Ecological quality (C) | Proportion of residential land area in construction land area (B_6) //% | Moderate | Processing and calculation |
| | | Noise compliance rate in township (B_7) //% | Positive | Statistical data |
| | | Resident happiness index (B_8) //points | Positive | Scoring by masses |
| | | Energy consumption per unit GDP (C_1) // tons of standard coal/10 000 yuan | Negative | Statistical data |
| | | Proportion of environmental protection expenditure in fiscal expenditure (C_2) //% | Moderate | Statistical data |
| | | Per capita area of ecological vegetation (C_3) //m ² /person | Positive | Statistical data |
| | | Harmless treatment rate of urban domestic garbage (C_4) //% | Positive | Statistical data |
| | | Urban sewage treatment rate (C_5) //% | Positive | Statistical data |
| | | Ambient air compliance rate (C_6) //% | Positive | Statistical data |

Table 6 Weight of evaluation indices for high-quality development of characteristic towns under perspective of production-living-ecology integration

| T | A | B | C | Final weight |
|-------|---------|---------|---------|--------------|
| | 0.452 9 | 0.314 7 | 0.232 4 | |
| A_1 | 0.034 7 | | | 0.015 7 |
| A_2 | 0.076 0 | | | 0.034 4 |
| A_3 | 0.261 9 | | | 0.118 6 |
| A_4 | 0.060 4 | | | 0.027 4 |
| A_5 | 0.124 7 | | | 0.056 5 |
| A_6 | 0.383 4 | | | 0.173 6 |
| A_7 | 0.058 9 | | | 0.026 7 |
| B_1 | | 0.209 6 | | 0.066 0 |
| B_2 | | 0.109 0 | | 0.034 3 |
| B_3 | | 0.046 2 | | 0.014 5 |
| B_4 | | 0.069 7 | | 0.021 9 |
| B_5 | | 0.278 1 | | 0.087 5 |
| B_6 | | 0.201 2 | | 0.063 3 |
| B_7 | | 0.049 7 | | 0.015 6 |
| B_8 | | 0.036 4 | | 0.011 5 |
| C_1 | | | 0.134 4 | 0.031 2 |
| C_2 | | | 0.059 3 | 0.013 8 |
| C_3 | | | 0.066 6 | 0.015 5 |
| C_4 | | | 0.228 3 | 0.053 0 |
| C_5 | | | 0.232 3 | 0.054 0 |
| C_6 | | | 0.279 0 | 0.064 8 |

3.4 Weight determination of the indices Based on the evaluation system for high-quality development of characteristic towns under the perspective of production-living-ecology integration, the indices were weighted using YAAHP 10.3. The detailed data are shown in Table 6.

4 Conclusions and policy implications

4.1 Conclusions The evaluation system for high-quality development of characteristic towns under the perspective of production-living-ecology integration involves three aspects of production, ecology and living. It fully reflects the comprehensiveness of the connotation of high-quality development of characteristic towns.

For the general goal of high-quality development of characteristic towns under perspective of production-living-ecology integration, the weights of indices at each criterion level are in the following order: production quality $A >$ living quality $B >$ ecological quality C . It can be seen that industrial development is the foundation of survival for the construction of characteristic towns. The weights of living quality indices and ecological quality indices have increased, and living quality and ecological quality have attracted more attention in the process of building characteristic towns.

For the criterion level of production quality, the weights of the indices in the plan level ranked as industrial chain competitiveness level $A_6 >$ characteristic industry investment $A_3 >$ GDP energy consumption reduction rate $A_5 >$ proportion of per capita disposable income in GDP $A_2 >$ proportion of the operating income of charac-

teristic industries in the operating income of the town $A_4 >$ talent attraction policy $A_7 >$ per capita GDP A_1 . Industrial competitiveness and capital investment are still the core factors for the improvement of industrial quality.

For the criterion level of living quality, the weights of the indices in the plan level were in the order as reasonable sharing of public resources $B_5 >$ public transportation convenience $B_1 >$ proportion of residential land area in construction land area $B_6 >$ public WIFI coverage $B_2 >$ hospital beds owned by per thousand people $B_4 >$ per capita construction area of public cultural facilities $B_3 >$ residents' happiness index B_8 . The sharing economy has become an important measure of the quality of living in characteristic towns.

For the criterion level of ecological quality, the weights of the indices in the plan level ranked as ambient air compliance rate $C_6 >$ urban sewage treatment rate $C_5 >$ harmless treatment rate of urban domestic garbage $C_4 >$ energy consumption per unit GDP $C_1 >$ per capita area of ecological vegetation $C_3 >$ proportion of environmental protection expenditure in fiscal expenditure C_2 .

4.2 Policy implications

4.2.1 Concept of production-living-ecology integration. Production-living-ecological space and production-living-ecological functions are the trend and inevitable requirement of the high-quality development of characteristic towns, as well as essential connotation^[11-17]. The high-quality development of characteristic towns must be supported by their own power: characteristic industries. They must also be suitable for human habitation: livability. More importantly, they must realize the harmonious development of man and nature: green mountains and clear waters.

4.2.2 Production. In terms of production aspect of characteristic town construction, it is necessary to select industries with their own advantages and characteristics and potential for development as characteristic industries, optimize the intensive and efficient production space, create a full industrial chain of characteristic industries, improve the competitiveness of characteristic industries, increase policy preferences, and attract commercial capital to invest in characteristic industries, thereby realizing the scale effect of characteristic industries as soon as possible with capital operation as the driving force.

4.2.3 Living. In terms of living, in the construction of characteristic towns, it is necessary to further improve life service facilities, create a good living culture and quality of life, and attract the population to gather in characteristic towns to realize the virtuous cycle of "production" attracting talents and "life" retaining talents. Connotative livable life and the residence of talents can form a cohesive community. Even if the industry declines, the talent pool can rediscover new industry opportunities in the decline. This also embodies the new urbanization spirit of "human" urbanization.

4.2.4 Ecology. In the ecological aspect of the construction of characteristic towns, it is necessary to clarify the main responsibility of ecological protection, give full play to the active role of governments, enterprises and individuals in ecological protection, include the residents of small towns in an important category of ecological protection, deal with the problems of ecological protection and the production and life of town residents, make full use of the

advantages of small town's ecological resources and develop ecological industries, to transform ecological advantages into competitive advantages to provide continuous impetus for the high-quality development of characteristic towns.

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