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Research on the Coupling Coordination of Tourism industry-Urbanization-Ecological Environment in Shandong Province

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Abstract: The coordinated development of the tourism industry, urbanization and ecological environment is of vital importance to build strong economic and cultural province, as well as to implement "Four Regional Strategies" in Shandong province. Base on the coupling mechanism of three systems of tourism industry, urbanization and ecological environment, this paper builds evaluation indicator of the complex system, introduces the model coordinated development degree, to make quantitative analysis for the coordinated development degree of Shandong Province from 2001 to 2013.

Keywords: *Tourism industry; urbanization; ecological environment; Coupling Coordination; Shandong Province*

1. Introduction

Urbanization is the path we must take to achieve modernization, and the level of urbanization is an important sign of regional economic development and ecological progress. After more than three decades' development, our national urbanization, which was 17.9% in 1978, has reached 53.7% in 2013. And urbanization in Shandong province in 2013 reached 53.75%, surpassing the average national performance. The implementation of the "Four Regional Strategies" has further sped up the development of urbanization in Shandong, which stimulates the development of the tourist industry, making it the real strategic supporting industry of Shandong. After entering the new normal, urbanization and tourist industry have been offering great engines for our national economic and social development and great potentials for expanding the domestic demand. As a result, pressing ahead with the development of urbanization and tourist industry has realistic significance to the upgrading of the regional industrial structure and the protection of the ecological environment. As urbanization and tourist industry develop rapidly, how should we make use of the concentration, diffusion and interconnectedness of ecological tourism to promote urbanization and cities' comprehensive development ability within the bearing capacity of eco-environment? Improving the conditional support system of tourism through urbanization and achieving the three systems' benign interaction and coordinated development is the key for Shandong to become a powerful economic and cultural province and to implement the "Four Regional Strategies".

2. Literature Review

As for studies of tourism, urbanization and eco-environment, the perspectives of national and international scholars are as follows:

Firstly, in terms of study contents, Mullins proposed "Tourism Urbanization" and built the theoretical framework in accordance [1]. After that, many scholars began to explore and discuss the characteristics and types of tourism urbanization on theoretical level to prove its driven mechanism when forming and realization model. The relations between tourism and eco-environment include aspects such as ecological tourism, sustainable tourism management, environmental regulation, and mutual impacts between them. For instance, Grossman and Krueger put forward the Environment Kuznets Curve (EKC) theory [2]; in terms of urbanization and eco-environment, scholars such as Ascione 、Martínez and Maruotti explored and discussed the effects and their coefficient of urbanization and economic growth of cities to resources and environmental pollution [3]; York analyzed the constraint mechanisms and effects to the urbanization process in terms of environmental bearing capacity and eco-security. As the imbalances among tourism, urbanization and eco-environment became increasingly acute, Chinese scholars conducted a series of studies and thus produced a cluster of achievements [4][5].

Secondly, in terms of study methods and areas, researchers abroad mainly use the environmental indicator Pressure-State-Response (P-S-R) conceptual model [6], ecological footprint model and energy analysis to analyze the relations of tourism, urbanization and eco-environment in different regions; earlier Chinese scholars mainly analyzed qualitatively the interactive relations among the above three systems while later, the frequent application of econometric model and coupling evaluation model prompted them to make discussions in areas such as coupling relations [7], function mechanisms, driving factors and spatial evolutions of tourism, urbanization

and environment in different regions (i.e. nationwide, Yangtze River Delta, Pearl River Delta , Northeastern city clusters and so on) [8][9][10].

Through the analysis of present study results, it's easy to find out that most research put an emphasis on the separate analysis of tourism, urbanization and eco-environment while empirical studies to combine the three components into one frame are rare. Studies to analyze provincial compound system's development of coupling and coordination on a dynamic and spatial differentiation contrasted basis in spatial and temporal dimension are much weaker.

So, taking Shandong province as an example, this paper systematically builds an coupling and coordination evaluation model on tourism, urbanization and eco-environment, measures quantitatively the coupling degree and coordination degree of this province's compound system from 2001 to 2013 and conducts timing analysis and spatial comparison in terms of its coordinated development in an attempt to forge a scientific analysis on the current situation of development and coupling and coordination trend, to provide the sustainable development of Shandong's new urbanization and eco-tourism with scientific foundation and theoretical support.

3. Coupling and coordination mechanism

Tour is industry-urbanization-ecological environment is an open system with meaningful richness, structural complication and coupling characteristics, each of which improves and constraints the other two and can only realize sustainable development through their coordinated operation on a coupling basis [11].

Urbanization is a spatial and temporal process during which industrialization and economy develops rapidly. It can boost economic growth and stimulate changes both of the environment and people's behavior. The improvement of urban public infrastructure, the upgrading of transportation network structure and the remodeling of people's living environment have provided necessary foundation for the integrated development and increasing experiencing value of tourism industry. However, the development of urbanization is closely linked to good eco-environment which serves as an objective carrier and in turn; urbanization can offer fund and technology to the building of eco-environment. Eco-environment provides resources for the development of urbanization and a good eco-environment can attract investment and optimize regional industrial structure, so as to raise the quality of urbanization. However, the changes of eco-environment will restrict the quality and scale of urbanization, too.

The driving forces and merging effects of tourist industry bring about agglomeration of population and industries, which drives the formation of spatial and population urbanization and a new situation of "industrial interconnectedness and industry boosting urbanization". The two factors interact with each other in a healthy way and achieve integrated development. Upgrading factors of urbanization such as environmental regulation and life happiness indicator also witness improvement thanks to the development of tourism. With tourism being an energy-conserving and environment-friendly industry, rational development and management are good to the sustainable use of both natural and cultural resources and the eco-environment, while rapid but unplanned development will cause air, water and noise pollution, damage and disruption of animals, plants and scenic environment to the destination [12].

In conclusion, tourism industry, urbanization and eco-environment present a coupling relationship of mutual influence. How to coordinate the three systems to achieve sustainable development of regional urbanization, tourism industry and eco-environment is of vital importance to regional sustainable development.

4. The building of coupling and coordination degree model

4.1. Indicator system

Coupling refers to a phenomenon that two or more systems influence each other through interaction and thus reach synergy. Considering coupling's connotation in terms of tourism, urbanization and eco-environment, the scientific and complete principles of the indicator as well as the availability of the data, with a reference to former studies, and based on relative literatures and expert consultations, we choose 24 detailed one-way indicators and build the coupling and coordination development evaluation indicator system of tourism industry, urbanization and eco-environment. The determination of indicator weights adopts the entropy value method, which could obliterate the bias caused by subjective factors to some extent. Meanwhile, maximum difference normalization method is pulled out to deal with the chosen indicators. As a result, indicators and their weights of the above three systems are drew. The details will not be reiterated here (Table 1).

Table 1: *Indicator system and its weight of tourism industry-urbanization -ecological environment system*

Criteria Hierarchy	Indicator Hierarchy/Unit	Weight
f(T)	Foreign Exchange Earnings from Tourism /10,000 USD	0.132
	Domestic Tourism Income/10^8 CNY	0.148
	Tourism Contribution to GDP/%	0.086
	Inbound Tourists Arrival/10,000 persons	0.119
	Domestic Tourists Arrival/10,000 persons	0.139
	Number of Star Rated Hotels/pieces	0.084
	Number of Travel Agencies/pieces	0.077

	Number of Tourism practitioners /10,000 persons	0.216
g(U)	Urbanization Rate/%	0.095
	GDP Per Capita/CNY	0.153
	Secondary Industry Contribution to GDP/%	0.109
	Tertiary Industry Contribution to GDP/%	0.137
	Gross Fixed Investment/CNY	0.153
	Urban Disposable Income/CNY	0.165
	Urban Engel Coefficient/%	0.114
	Ratio of Tertiary Industry Workers/%	0.075
h(E)	Industrial Wastewater Discharge Amount/ 10,000 t	0.133
	Industrial SO_2 Emission Amount/ 10,000 t	0.114
	Urban wastewater Discharge Amount / 10,000 t	0.151
	Industrial Solid Waste Generation Amount /10,000 t	0.149
	Annual Wastewater Treatment Rate/%	0.153
	Household Waste Harmless Treatment Rate/%	0.082
	Comprehensive Reuse Rate of Industrial Waste/%	0.083
	Urban Green Coverage Rate/%	0.135

Data of this paper mainly come from Shandong Year Book from 2001 to 2013, Shandong Statistic Year Book from 2001 to 2013, China City Statistic Year Book from 2001 to 2013 and the statistic year books of Shandong's 17 cities from 2001 to 2013.

4.2. Coupling and coordination degree model

With reference to the capacity coupling system model in physics, the coupling model of tourism industry, urbanization and ecological environment can be drawn by extension as follows:

$$C = \sqrt[3]{\frac{f(T)g(U)h(E)}{[f(T)+g(U)+h(E)]^3}} \quad (1)$$

In formula (1), C represents the coordination degree of tourism, urbanization and eco-environment, *f(T), g(U), h(E)* refer to evaluation indicators of tourism industry, urbanization and ecological environment respectively.

Coupling degree describes the matching level of tourism, urbanization and eco-environment. However, it cannot identify the matching level. Thus, the coupling and coordination degree model of the coordinated development level of tourism, urbanization and eco-environment is introduced here, i.e.

$$D = \sqrt{C*T} \quad T = \alpha f(T)+\beta g(U)+\delta h(E) \quad (2)$$

In formula (2), D represents coupling and coordination degree, T represents comprehensive evaluation indicator of tourism industry-urbanization-ecological environment, α, β, δ are undetermined coefficient. Considering the relations among tourism, urbanization and eco-environment and others' study results, we assume $\alpha=0.2, \beta=0.4, \delta=0.4$.

5. Dynamic spatial distribution evolution characteristics

5.1. Temporal evolution characteristics

Based on formula (1) and (2), the specific cross-sectional data of the 17 Shandong cities in terms of the three sub-systems in 2001, 2007 and 2013 can be calculated (Table 2).

Qingdao, Jinan and Yantai dominated the top 3 in tourism in the 3 years, especially Qingdao, which demonstrated a distinct advantage in tourist industry because of its influence on urbanization brand and attractiveness on tourist resources. Relatively developed regions included Weihai, Zibo, Linyi and Weifang, which showed lower development level in 2007 than that of 2001 due to the global financial crisis in 2007 and 2008. Western cities - Heze, Liaocheng, Dezhou and Binzhou - possessed a low-level and slow growth-rate tourist development.

In terms of urbanization, the capital city Jinan has taken a lead between 2001 and 2013, followed by Qingdao, Yantai, Weihai and Dongying. Cities such as Jinan, Qingdao, Tai'an, Weifang, Yantai, Weihai and Linyi have accomplished some achievements, coincided with these tourism-advantageous ones perfectly, which indicated that urbanization has played a significant role in tourist development. Heze, as the underdeveloped area in Shandong, ranked last in urbanization development.

In terms of eco-environment, the comprehensive indicators of Tai'an, Weihai, Rizhao and Dongying made a lot of progress in 2007 and 2013, indicating they have kept a good eco-environment as their tourism developed. In contrast, indicators of Zibo and Jining fell in 2007 compared to that in 2001, because their extensive and rapid urbanization and spatial expansion has deteriorated the eco-environment. In 2013, the indicators rose again thanks to the strengthened protection measures.

Table 2:*The indicator in 2001, 2007and 2013 of 17 cities in Shandong Province*

City	2001			2007			2013		
	f(T)	*g(U)*	*h(E)*	*f(T)*	*g(U)*	*h(E)*	*f(T)*	*g(U)*	*h(E)*
Jinan	0.572	0.708	0.636	0.528	0.653	0.394	0.585	0.65	0.554
Qingdao	0.974	0.635	0.821	0.928	0.664	0.520	0.876	0.642	0.585
Zibo	0.243	0.464	0.452	0.209	0.521	0.336	0.281	0.505	0.49
Zaozhuang	0.127	0.275	0.35	0.063	0.317	0.519	0.111	0.302	0.684
Dongying	0.035	0.587	0.429	0.047	0.626	0.681	0.1	0.616	0.76

Yantai	0.575	0.504	0.584	0.455	0.582	0.503	0.536	0.53	0.541
Weifang	0.278	0.357	0.556	0.215	0.460	0.604	0.425	0.47	0.491
Jining	0.338	0.32	0.383	0.265	0.362	0.515	0.364	0.328	0.406
Tai'an	0.377	0.342	0.563	0.281	0.320	0.720	0.411	0.397	0.759
Weihai	0.37	0.533	0.699	0.316	0.539	0.855	0.373	0.498	0.854
Rizhao	0.171	0.318	0.449	0.198	0.305	0.751	0.265	0.331	0.738
Laiwu	0.023	0.328	0.469	0.014	0.339	0.709	0.025	0.335	0.737
Linyi	0.244	0.331	0.322	0.220	0.386	0.687	0.501	0.444	0.578
Dezhou	0.083	0.274	0.462	0.057	0.307	0.480	0.11	0.325	0.744
Liaocheng	0.134	0.197	0.525	0.071	0.262	0.602	0.095	0.318	0.792
Binzhou	0.037	0.291	0.436	0.022	0.375	0.459	0.054	0.414	0.606
Heze	0.024	0.075	0.052	0.022	0.147	0.889	0.037	0.171	0.196

5.2. Spatial distribution evolution characteristics

5.2.1. Spatial distribution evolution on coupling degree

The balance degree of tourism, urbanization and eco-environment which are quite synchronized, can be reflected through coupling degree. To further conduct a spatial dynamic analysis on coupling degree, we calculated the coupling degree of the 17 cities in 2001, 2007 and 203 respectively and processed the data. The results can be seen in figure 4. According to the calculated results, the coupling degree of tourism industry, urbanization and ecological environment of regional cities displays a non-balanced spatial pattern. Coupling degrees in Jinan, Qingdao, Zibo, Yantai, Weifang, Jining, Tai'an, Weihai, and Linyi is obviously higher than those of the other regions, while the coupling degrees of Dongying, Laiwu, Binzhou and Heze is relatively low.

In 2001, cities on a running-in stage of tourism industry-urbanization-ecological environment included: Dongying, Laiwu and Binzhou. Development in these three cities, whose economic bases were rather weak, started relatively late. As a result, their urbanization levels were low. Similarly, tourism industries in these cities had late starts with weak bases and thus very outdated. Other cities were on the high coupling stage, which did not mean high coordination degree.

In 2007, Zaozhuang, Dezhou and Liaocheng reversed to the running-in stage. Meanwhile, changes in other cities were not obvious, but coupling degrees of the majority fell in varying degrees compared to those of 2001. In 2007 and 2008, sluggish economic growth rate caused by global financial crisis discouraged the development of urbanization and tourism. Therefore, the coupling degree slid. In 2013, Dongying, Laiwu and Binzhou were still on the running-in stage, of which the coupling degrees in Dongying and Binzhou have increased a little bit though that of Laiwu declined. Besides, coupling degrees in Dezhou, Binzhou, Heze, Liaocheng and Zaozhuang declined from high-quality to running-in stage. Urbanization and tourist industry in Dezhou and Binzhou have made a relatively small progress, thus turning to the running-in stage. Compared to other cities, Liaocheng, Zaozhuang and Heze had low growth-rate urbanization. What's more, due to scarcity in special tourist resources and weak tourism bases, their comprehensive indicators in tourist industry assumed a downward trend.

5.2.2. Spatial distribution evolution of coupling and coordination degree

By means of coupling and coordination formulae, the coupling and coordination degree of the 17 cities in 2001, 2007 and 2013 can be calculated. With ArcGIS clustering tool, the measurement results can be visualized as follows (Figure 1).

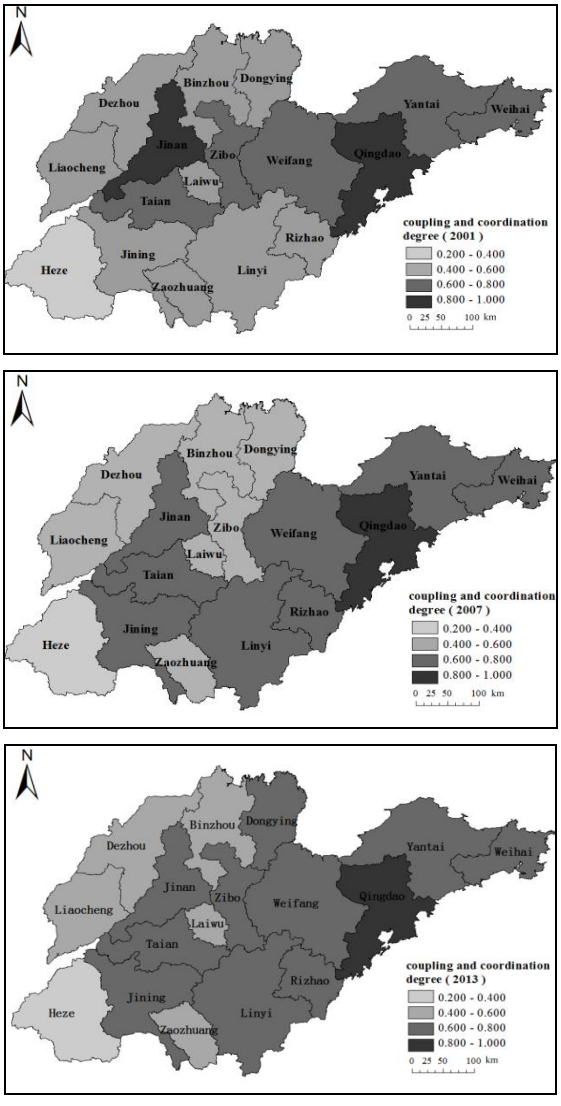

***Fig.1**: Changes of coupling coordination degree of 17 cities in Shandong Province*

According to figure 1, coordination degrees of tourism industry-urbanization-ecological environment in the 17 cities of Shandong province have improved in 2001, 2007 and 2013 in general. Still, distinct regional differences existed, presenting a spatial distribution of high in the east while low in the west.

In 2001, Jinan and Qingdao entered the high coordination stage. Blessed with an excellent geographical location, Qingdao has tremendous advantages in its tourist infrastructure and resources. Plus with its sustained policy support to tourism, the urbanization and eco-environmental protection in Qingdao have been promoted successfully. Jinan, capital of Shandong, has a relatively high urbanization rate, which has pushed the development of tourism and eco-environment conservation. Yantai, Weihai, Zibo, Weifang and Tai'an have achieved a moderate coordination among tourism, urbanization and eco-environment. Heze is moderately imbalanced, with its weak economic basis and low industrialization leading to the lowest urbanization level in Shandong and a rather low tourism development level as well. Besides, other cities are on the basic coordination stage.

Zibo, Weifang, Jining, Tai'an, Rizhao, Linyi, Yantai and Weihai have reached moderate coordination, because their high-level urbanization and good infrastructure have promoted the development of tourist industry. Zaozhuang, Dongying, Laiwu, Dezhou and Binzhou have achieved primary coordinated development of tourism industry-urbanization-ecological environment, entering the basic coordination stage. In western areas, cities there have no good regional advantages and transportation accessibility, developed economy, large-scale openness or beneficial policies as those coastal cities; to make it worse, they possess scarce tourist resources and poor infrastructure which have caused inadequate accommodation, leading to the underdevelopment of their tourist industries. Heze is moderately imbalanced, with its weak economic basis and low industrialization leading to the lowest urbanization level in Shandong and a rather low tourism development level as well.

In 2007, Jinan slid from high to moderate coordination. As the capital city of Shandong province, solid urbanization basis and excellent advantages in tourist resources have promoted its tourism to develop rapidly. However, Jinan adopted an extensive tourist development process, during which the number of tourists has increased and the industrial scale expanded. Thus, emissions of the three wastes (waste gas, waste water and waste residues) brought about through the process intensified. The coping capacity of production and living wastes was rather limited, making eco-environment's restriction and negative feedback to tourism increasingly more serious. Zibo has reversed to the basic stage, the development of high energy-consuming industries such as mining, chemistry and ceramic industries resulting in its environment deterioration. Jining, Rizhao and Linyi have progressed from basic to moderate coordination stage.

In 2013, Qingdao was the only high-coordinated city, all its three sub-systems maintaining a relatively high level respectively. Except that Laiwu, whose urbanization basis was weak and tourist resources rare, was on the basic, while Heze on the moderate imbalanced stage, all the other cities have reached moderate coordination. Zaozhuang, Dongying, Laiwu, Dezhou and Binzhou have developed from basic to moderate coordination stage. And Zaozhuang, Jining, Linyi, Dezhou and Liaocheng, benefited from the "One Belt" (western economic booming area development plan) Strategy, have achieved huge progress in eco-environment conservation, new urbanization development and the upgrading and transformation of tourism.

5.2.3. Spatial types of coupling and coordination development

Integrating the coupling and coordination degrees of tourism, urbanization and eco-environment of the 17 cities together, the areas can be divided into 4 types. The spatial visualized results can be seen in figure 2.
Type I: harmonious zone, or high coupling and coordination zone, whose coupling degree and coordination degree both stand beyond 0.8. In 2001, Jinan and Qingdao fell into this category while in 2007 and 20013, only Qingdao did. As an important regional developed city, urbanization and tourism in Qingdao should be committed to an intensive layout and improved structure, service environment and quality in the future.
Type II: running-in zone, or high coupling and moderate coordination zone, whose coupling degree surpasses 0.8 while coordination degree stands between 0.6 and 0.8. In 2001, cities belonged to this type included Zibo, Yantai, Weifang, Tai'an and Weihai. In 2007, Zaozhuang and Dongying elevated to running-in zone while Jinan declined to this category from harmonious zone and Binzhou to antagonistic zone from running-in zone. For cities of this type, they should further optimize the urbanization spatial pattern and tap into development potentials and efficiency of tourist resources.
Type III: antagonistic zone, or moderate coupling and low coordination zone, whose coupling degree is between 0.3~0.5 and coordination degree less than 0.5. In 2001, Dongying and Laiwu were antagonistic zones while in 2007, Heze, Laiwu and Binzhou were. In 2013, only Laiwu still belonged to this type. For this kind of cities, on one hand, urbanization expansion is necessary; on the other hand, ecological tourism should be developed.
Type IV: low-coupling zone. In 2001, 2007 and 2013, only Heze ever belonged to this type in 2001. In low-coupling zone, interactions among tourism,

urbanization and eco-environment remain relatively small.

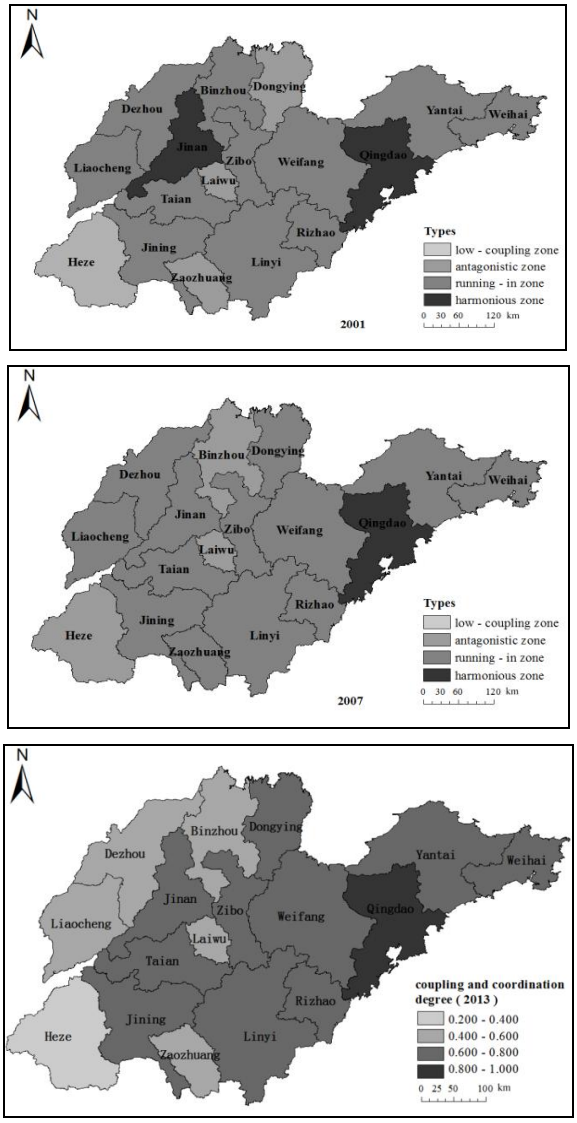

Fig.2*: Types of coupling coordinating areas*

6. Conclusions

By building the tourism industry-urbanization-ecological environment coupling and coordination model, this paper calculated the comprehensive evaluation indicators of Shandong province of the 17 cities under its governance. Then, it analyzed the spatial and temporal distribution of the coupling and coordination degree and their evolution process, and divided the regions into 4 types in terms of the coupling and coordination degree. Finally, the driving mechanism of the change of spatial and temporal distribution was analyzed. The conclusions are as follows:

(1) From the perspective of temporal evolution, tourism, urbanization and eco-environment in Shandong have all improved and their coupling degree grew from running-in stage to high-quality coupling stage in general between 2001 and 2013. In addition, its coordination degree developed from basic to moderate in general. As time changes, the three systems and their coupling and coordination system in the 17 cities displayed a fluctuant rising trend. On the whole, low urbanization level and lagging tourism development contribute mainly to their low-level coordinated development.

(2) From the perspective of spatial distribution evolution, there exist distinct regional differences in tourism-urbanization-ecological environment among the 17 cities. Cities with developed urbanization level and tourism industry, especially Qingdao, Jinan, Yantai and Weihai, have high coupling degrees in terms of tourism, urbanization and eco-environment on the high-quality coupling stage, while those of Heze, Binzhou and Laiwu are low. On the whole, it displays an east high and west low spatial pattern. The distribution of coupling degree and coupling coordination conforms to the spatial variation pattern and the "Four Regional Strategies", and the interactions of the three sub-systems coincide with regional realities in general, which indicate that the dependence and coordination of urbanization and tourism to eco-environment are improving. Besides, the construction of eco-environment becomes an important focus in the progress of Shandong's tourist industry.

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