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# Study and Integrative Evaluation on the development of Circular Economy of Shaanxi Province

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**Abstract**

A kind of index system used for evaluating the circular economy development of Shaanxi province was built in this paper based on the circular economy development's content and some basic principles that should be followed by the system, along with the current status of the circular economy development of Shaanxi province. This system includes five aspects that are social and economic development, resource efficiency, resource recycling and reuse, environment protection, pollution reduction. By using this system and principal component analysis as well as analytic hierarchy process, we studied the circular economy development of Shaanxi Province. The results show that circular economy development in this province is in steady upward developing. Finally, some advices for accelerating the circular economy development of Shaanxi were prompted.



*Keywords:* circular economic; Shaanxi province; principal component analysis; analytic hierarchy process; empirical analysis

## 1. Introduction

With the resources and environmental limitation which restraints the economic development has become more distinctive, traditional economic growth mode, such as high energy consumption, high pollution and high emissions, low efficiency, promotes the status of lacking energy, which seriously restricted sustainable economic development of Shaanxi Province. Circular economy is a new model of economic development, which can achieve sustainable development and resolve the conflict between the economic development and resource and energy consumption. The economy of Shaanxi province rapid very fast in recent years, but the energy consumption is higher than economic growth. According to the

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statistics in 2008, the province's total energy production is 2,229,356,300 tons of standard coal, about 8.8% of the nations. And the total standard coal consumption is about 72,193,500 tons, accounting for 2.5% of the nations, which is 8.7% more than the previous year but lower than the GDP growth rate for 6.9 percent [1]. In addition, urban domestic garbage treatment rate and urban sewage treatment rate are still hovering at a low level, however, carbon dioxide emissions has been at the forefront of the nations. Based on the above status, an evaluation system of circular economy development is constructed to evaluating the circular economical development of Shaanxi Province in this paper. This will provide a basis for making policies like economic and social development, resource utilities, environmental protection, and pollution reduction.

## 2. Construction of Circular Economy Development Index System

### *2.1. The basis for designing circular economy index system*

Circular economy is an economic growth mode which meets the concept of sustainable development. Its core is efficient use of resources and recycling; its principles are reduce, reuse, and recycle; and its basic features are low consumption, low emission and high efficiency [2]. So several basic principles about designing circular economy index system can be obtained.

- For circular economy, the most important thing is reduction of production.
- Reuse, recycling is an important part of circular economy.
- Environmental security is one of the goals of circular economy development.
- Social and economic development is a core of the development of circular economy.
- Circular economy is an important strategy for achieving sustainable development approach.

### *2.2. Principles for index system construction*

- A principle that should combine scientific property with practicability. The selection of specific indicators should be able to fully cover the strategic goal of circular economy development, meanwhile taking into account the difficulty and reliability of the data obtained.
- A principle that should combine systematic with understanding hierarchy. This means that index system should be able to fully reflect all aspects of the development of circular economy, but also avoid overlap between the indicators, meanwhile the structure of the system should be classified, making it clearly.
- “3R”Principle. Selection of the evaluation criteria of circular economy should follow the "3R" principle, because the core of the circular economy is to reflect the application situation and effect of "3R" standards of circular economy.

### *2.3. Index system construction*

The only data that could be used for advanced analysis are currently obtainable statistics and documents, because comprehensive index system is not available which was used for evaluating circular economic development in China for the difficulties to collecting data. Some valuable but not easy to collect or quantify will not be included in this system. According to the efforts above and refer to several foreign references [3-6], we construct the evaluation index system that is suitable to Shaanxi Province.

According to five aspects which are social and economic development, resource efficiency, resource recycling and reuse, environment protection, pollution reduction, this paper designs an evaluation system of circular economy development level of Shaanxi province. Indications show in table 1.

Table 1. Circular economy assessment index system

| Classified index system | Individual indicators | Unit |
|---|---|---|
| Social and economic development | X11:Gross Domestic Product | 100 million yuan |
| | X12: Per Capita GDP | 100 million yuan |
| | X13: Value-added of Secondary Industry | 100 million yuan |
| | X14: Value-added of Tertiary Industry | 100 million yuan |
| | X15: Output Value of Tertiary Industry account for GDP | % |
| | X16: Unemployment Rate in Urban Area | % |
| | X17: Engel's Coefficient | % |
| | X18: Spending on Education Total as of GDP | % |
| Resource efficiency | X21: Energy Consumption per 10 000-yuan GDP by Region | ten thousand RMB per to |
| | X22: Electricity Consumption per 10000-yuan GDP by Region | ten thousand RMB per KW |
| | X23: Elasticity Ratio of Energy Production | % |
| Resource recycling and reuse | X31: Ratio of Industrial Solid Wastes Utilized | % |
| | X32: Water Reuse Rate of Industrial Enterprises | % |
| | X33: Output Value of Products Made from Waste Gas, Waste Water & Solid Wastes account for GDP | % |
| Environment protection | X41: Per Capita Green Areas | sq.m |
| | X42: Urban Domestic Garbage Treatment Rate | % |
| | X43: Urban Sewage Treatment Rate | % |
| Pollution reduction | X51: Volume of Industrial Wastewater Discharged | 10 000 tons |
| | X52: Percentage of Industrial Wastewater Meeting Discharged Standards | % |
| | X53: Volume of Industrial Sulphur Dioxide Emission per 10000-yuan GDP by Region | ten thousand RMB per KG |
| | X54: Volume of Industrial Soot Removed | 10 000 tons |
| | X55: Volume of Industrial Dust Removed | 10 000 tons |
| | X56: Volume of Industrial Solid Wastes Discharged | 10 000 tons |
| | X57: Investment in Pollution Treatment account for GDP | % |
| | X58: Volume of Industrial Soot Discharged | tons |
| | X59:Percentage of Industrial Soot Meeting Discharged Standards | % |

### *2.4. Data collection*

Data are gathered according to the system constructed formerly. They are collected from China Economic Net[1], China Energy Statistical Yearbook[7], Shaanxi Statistical Yearbook[8], Environmental status bulletin of Shaanxi Province in 2004[9]. Then these data are classified and processed simply to generate a table which could represent the difference of circular economical development of Shaanxi Province annually. As shown in table 2.

Table 2. The data of circular economy assessment index system in Shaanxi province

| Indicators | 2004 | 2005 | 2006 | 2007 | 2008 | Mean | Std. Deviation |
|---|---|---|---|---|---|---|---|
| X11 | 3175.58 | 3772.69 | 4523.74 | 5465.79 | 6851.32 | 4757.8 | 1450.23 |
| X12 | 8587 | 10161 | 12138 | 14607 | 18246 | 12748 | 3809.94 |
| X13 | 1553.1 | 1946.31 | 2440.5 | 2964.56 | 3842.08 | 2549.3 | 896.04 |
| X14 | 1250.2 | 1390.55 | 1594.76 | 1908.6 | 2255.52 | 1679.9 | 405.97 |
| X15 | 39.37 | 36.86 | 35.25 | 34.91 | 32.92 | 35.9 | 2.41 |
| X16 | 3.8 | 4.2 | 4 | 4 | 3.9 | 4 | 0.15 |
| X17 | 39.15 | 39.5 | 36.65 | 36.6 | 37.05 | 37.8 | 1.42 |
| X18 | 1.54 | 1.84 | 1.98 | 1.9 | 1.56 | 1.8 | 0.2 |
| X21 | 1.72 | 1.48 | 1.43 | 1.36 | 1.28 | 1.5 | 0.17 |
| X22 | 1489 | 1405 | 1364.6 | 1340.24 | 1256.02 | 1371 | 85.57 |
| X23 | 3.76 | 1.24 | 0.56 | 1.07 | 1.74 | 1.7 | 1.24 |
| X31 | 27.77 | 24 | 38.2 | 41.6 | 40.28 | 34.4 | 7.95 |
| X32 | 85.35 | 86.2 | 88.1 | 79.75 | 86.31 | 85.1 | 3.18 |
| X33 | 0.014 | 0.17 | 0.22 | 0.29 | 0.18 | 0.2 | 0.1 |
| X41 | 4.51 | 5.1 | 7.1 | 8 | 8.7 | 6.7 | 1.82 |
| X42 | 35.2 | 39.7 | 44.5 | 52.4 | 68.5 | 48.1 | 13.08 |
| X43 | 28.7 | 31.9 | 43.6 | 51.2 | 46 | 40.3 | 9.58 |
| X51 | 3.68 | 4.28 | 4.05 | 4.85 | 4.81 | 4.3 | 0.5 |
| X52 | 90.7 | 91.2 | 95 | 97 | 97.31 | 94.2 | 3.14 |
| X53 | 22.24 | 21.2 | 18.7 | 15.47 | 11.77 | 17.9 | 4.3 |
| X54 | 431. 86 | 374.08 | 182.49 | 25.69 | 14.68 | 205.78 | 192.96 |
| X55 | 95.73 | 84.14 | 18.24 | 216.06 | 188.53 | 120.54 | 80.85 |
| X56 | 32.35 | 34.87 | 42.91 | 42.26 | 26.35 | 35.7 | 6.97 |
| X57 | 1.19 | 1.3 | 3.6 | 0.8 | 1.1 | 1.6 | 1.13 |
| X58 | 28.63 | 18.69 | 26.62 | 25.69 | 14.68 | 22.86 | 5.91 |
| X59 | 58.7 | 63.9 | 89.3 | 86.2 | 96.9 | 78.9 | 16.64 |

*2.5. Non-dimensional data processing*

Because different variables have different dimensions, it will be hard to integrate the result. In order to eliminate the impact of index dimension, there is a necessity to operate the non-dimensional data processing. This paper adopts standardization processing method [10].

If the evaluation index is positive indicator, the index value which is made by the standardized processing is $x_{ij} = \frac{X_{ij} - \overline{X}_i}{S_i}$. *(1)*

If the index is a reverse indicator, the index value which is made by the standardized processing is $x_{ij} = \frac{\overline{X}_i - X_{ij}}{S_i}$. *(2)*

(Positive indicators are conducive to the development of circular economy, reverse indicator hinder the development of circular economy.)

When the original data is Non-dimensional data processed by using the standard method mentioned above, the standardized data is obtained, as shown in table 3.

Table 3. Standardized data sheet of statistical indicator system of Shaanxi province circular economy

| indicators | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|
| X11 | -1.0910 | -0.6793 | -0.1614 | 0.4882 | 1.4436 |
| X12 | -1.0921 | -0.6790 | -0.1601 | 0.4879 | 1.4431 |
| X13 | -1.1118 | -0.6729 | -0.1214 | 0.4634 | 1.4428 |
| X14 | -1.0584 | -0.7127 | -0.2097 | 0.5633 | 1.4179 |
| X15 | 1.4554 | 0.4141 | -0.2539 | -0.3950 | -1.2206 |
| X16 | 1.2136 | -1.4833 | -0.1348 | -0.1348 | 0.5394 |
| X17 | -0.9594 | -1.2064 | 0.8042 | 0.8395 | 0.5221 |
| X18 | -1.1106 | 0.3768 | 1.0710 | 0.6743 | -1.0115 |
| X21 | -1.5960 | 0.1560 | -0.1440 | -0.5640 | -1.0440 |
| X22 | -1.3790 | -0.3973 | 0.0748 | 0.3595 | 1.3437 |
| X23 | -1.6823 | 0.3500 | 0.8984 | 0.4871 | -0.0532 |
| X31 | -0.8299 | -1.3040 | 0.4816 | 0.9092 | 0.7432 |
| X32 | 0.0655 | 0.3331 | 0.9313 | -1.6977 | 0.3677 |
| X33 | -1.5840 | -0.0473 | 0.4453 | 1.1348 | 0.0512 |
| X41 | -1.1954 | -0.8707 | 0.2301 | 0.7254 | 1.1107 |
| X42 | -0.9830 | -0.6390 | -0.2721 | 0.3317 | 1.5624 |
| X43 | -1.2084 | -0.8745 | 0.3465 | 1.1396 | 0.5969 |
| X51 | 1.3062 | 0.1097 | 0.5642 | -1.0303 | -0.9497 |
| X52 | -1.1287 | -0.9693 | 0.2415 | 1.0303 | 0.9497 |
| X53 | -1.0157 | -0.7736 | -0.1918 | 0.5600 | 1.4211 |
| X54 | 1.1718 | 0.8723 | -0.1206 | -0.9332 | -0.9903 |
| X55 | -0.3068 | -0.4502 | -1.2651 | 1.1813 | 0.8409 |
| X56 | -0.4875 | -0.1260 | 1.0275 | 0.9342 | -1.3483 |
| X57 | 0.3596 | 0.2627 | -1.7647 | 0.7034 | 0.4390 |
| X58 | -0.9759 | 0.7063 | -0.6363 | -0.4783 | 1.3839 |
| X59 | -1.2162 | -0.9038 | 0.6225 | 0.4363 | 1.0792 |

### *2.6. Weight determination*

There are many indicators need to be considered when constructing the system, but data of pollution emission reduction indicators of Shaanxi are collected until 2004, and some indicator's data are only available of the past five years. If adopt the factor analysis alone, index will be overabundance but lack sufficient supporting data; if use AHP, index will be overabundance and comparison matrix indicator will be inconsistent. Therefore, according to the synthetic evaluation indicator system and the special data's

characteristic of Shaanxi Province circular economy, this article chooses the method which combines the factorial analysis with the analytic hierarchy process to weight determination.

*2.6.1. Factor solution process*

- The factor solution of social and economy development

Base on these standardized data, by using SPSS statistical software [11] and principal component analysis extracted factors, the initial eigenvalues, the contribution rate and the cumulative contribution rate are obtained, as shown in table 4.

Table 4. Total variance explained

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 5.517 | 68.960 | 68.960 | 5.517E0 | 68.960 | 68.960 |
| 2 | 1.767 | 22.084 | 91.044 | 1.767E0 | 22.084 | 91.044 |
| 3 | .694 | 8.679 | 99.723 | | | |
| 4 | .022 | .277 | 100.000 | | | |
| 5 | 2.048E-16 | 2.560E-15 | 100.000 | | | |
| 6 | 1.356E-17 | 1.695E-16 | 100.000 | | | |
| 7 | -6.652E-17 | -8.315E-16 | 100.000 | | | |

According to the table 4, when the factor integer equals two, the cumulative contribution rate is 91.044%.Therefore two factors are enough to reflect the overall information, taking these two factors as the first principal components factor F11 and the second principal components factor F12 separately, then obtain factor loading. However, the factor variable has a high load in many variables because it doesn't undergone revolving in load. We can obtain the rotated factor loading matrix by rotating the factor loading matrix according to equation enormous method, as shown in table5. The purpose of factor analysis is to calculate factor scores. The matrix of factor score can be obtained according to the SPSS software analysis, as shown in table 6.

Table 5 Rotated component Matrix

| | Component | |
|---|---|---|
| | 1 | 2 |
| X11 | .988 | .105 |
| X12 | .988 | .104 |
| X13 | .990 | .092 |
| X14 | .986 | .118 |
| X15 | -.970 | .189 |
| X16 | .066 | .874 |
| X17 | .813 | -.172 |
| X18 | .047 | -.947 |

Table 6 Component Score Coefficient Matrix

| | Component | |
|---|---|---|
| | 1 | 2 |
| X11 | .178 | .049 |
| X12 | .178 | .048 |
| X13 | .179 | .041 |
| X14 | .178 | .056 |
| X15 | -.178 | .117 |
| X16 | .003 | .493 |
| X17 | .149 | -.106 |
| X18 | .019 | -.536 |

According to the matrix of factor score, the equal factor function is

$$F_{11}=0.178x_{11}+0.178x_{12}+...+0.019x_{18} \quad (3)$$

$$F_{12}=0.049x_{11}+0.048x_{12}+...-0.536x_{18} \quad (4)$$

In this analysis, the results which obtained from factor analysis could be used for comprehensive judgments. The weight of the different factor variables can be determined, according to the contribution rate of eigenvalues. By using comprehensive judgments formula [10] $F_1 = aF_{11} + bF_{12}$, we could gain the integrate score. The weight of coefficients can be calculated according to the table 4, which are $a = 0.69, b = 0.22$. Thus we could get the integrate score of economic and social development subsystem

$$F_1 = 0.69F_{11} + 0.22F_{12} \tag{5}$$

In the same way:

- The comprehensive score of resource efficiency subsystemis

$$F_2 = 0.401x_{21} + 0.307x_{22} + 0.463x_{23} \tag{6}$$

- The comprehensive score of resource recycling and reuse subsystemis

$$F_3 = 0.437x_{31} - 0.344x_{32} + 0.453x_{33} \tag{7}$$

- The comprehensive score of environment protection subsystemis

$$F_4 = 0.365x_{41} + 0.339x_{42} + 0.343x_{43} \tag{8}$$

- The equal score of pollution reduction subsystemis

$$F_{51} = -0.141x_{51} + 0.221x_{52} + ... + 0.241x_{59} \tag{9}$$

$$F_{52} = -0.16x_{51} + 0.003x_{52} + ... - 0.238x_{59} \tag{10}$$

$$F_{53} = 0.022x_{51} - 0.126x_{52} + ... + 0.063x_{59} \tag{11}$$

- Therefore, the comprehensive score of pollution reduction subsystemis

$$F_5 = 0.59F_{51} + 0.24F_{52} + 0.12F_{53} \tag{12}$$

*2.6.2. Determination of various subsystems weight by using the analytic hierarchy process*

Analytic hierarchy process is a kind of process [12] which decomposed complex problems into several important elements according to the numbers of factors and their relationship include in these problems, and then incorporate them into different levels to forming a multi-level structure. We can compare each couple of factors at each layer one by one according to a principle to establishing a judgment matrix. In the judgment matrix construct processing, every indicators need to be compared respectively to transforming experts' qualitative description into the standardized value based on “the relatively important degree value table”, as shown in table 7.

Take F1, F2, F3, F4, F5 as social and economy development, resource efficiency, resource recycling and reuse, environment protection, and pollution reduction. And meanwhile, each subsystem should be compared in pairs respectively to determining the judgment matrix, as shown in table 8. By using the yaahp software, and based on the e^ (0/5) ~e^ (8/5) scaling method, the comparison matrix could be constructed. And with respect to the calculation of judgment matrix uniform proportion, we can find the uniformity is acceptable (C.R. =0.000<0.1), and the weight of each subsystem can be got, as shown in table 9.

Table 7. The relatively important degree value table

| the relatively important degree value | meaning |
|---|---|
| 1 | similarly important |
| 3 | slightly important |
| 5 | important |
| 7 | much more important |
| 9 | great importance |
| 2,4,6,8 | above judgment neighboring value |

Table 8. The judgment matrix

| | F1 | F2 | F3 | F4 | F5 |
|---|---|---|---|---|---|
| F1 | 1 | 1/2 | 1/3 | 1/3 | 1/3 |
| F2 | 2 | 1 | 1/2 | 1/2 | 1/2 |
| F3 | 3 | 2 | 1 | 1 | 1 |
| F4 | 3 | 2 | 1 | 1 | 1 |
| F5 | 3 | 2 | 1 | 1 | 1 |

Table 9. The weight of judgment matrix

| | F1 | F2 | F3 | F4 | F5 | Wi |
|---|---|---|---|---|---|---|
| F1 | 1.00 | 0.82 | 0.67 | 0.67 | 0.67 | 0.15 |
| F2 | 1.22 | 1.00 | 0.82 | 0.82 | 0.82 | 0.18 |
| F3 | 1.49 | 1.22 | 1.00 | 1.00 | 1.00 | 0.22 |
| F4 | 1.49 | 1.22 | 1.00 | 1.00 | 1.00 | 0.22 |
| F5 | 1.49 | 1.22 | 1.00 | 1.00 | 1.00 | 0.22 |

Finally, the comprehensive score of circular economy function is

$$F=0.1493F_1+0.1824F_2+0.2228F_3+0.2228F_4+0.2228F_5 \quad (13)$$

### *2.7. Comprehensive Evaluation Scores of Circular Economy*

By using the value of each subsystem's indicator and comprehensive evaluation function above, the final comprehensive score of each subsystemcan be evaluated, as shown in table 10.

Table 10. Comprehensive evaluation form of circular economy in Shaanxi Province

| | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|
| F1 | -0.5488 | -0.7064 | -0.1259 | 0.2874 | 1.0938 |
| F2 | -1.8423 | 0.1026 | 0.3812 | 0.1097 | -0.0308 |
| F3 | -1.1028 | -0.7059 | 0.0918 | 1.4954 | 0.2215 |
| F4 | -1.1841 | -0.8344 | 0.1106 | 0.7681 | 1.1398 |
| F5 | -0.7044 | -0.4067 | -0.2512 | 0.6067 | 0.7716 |
| F | -1.0844 | -0.5205 | 0.0398 | 0.7024 | 0.6329 |

### *2.8. An analysis for the result of circular economy indicator's evaluations in Shaanxi province*

According to table 10, we can get fig.1, which is the development trend of Shaanxi province circular economy systems.

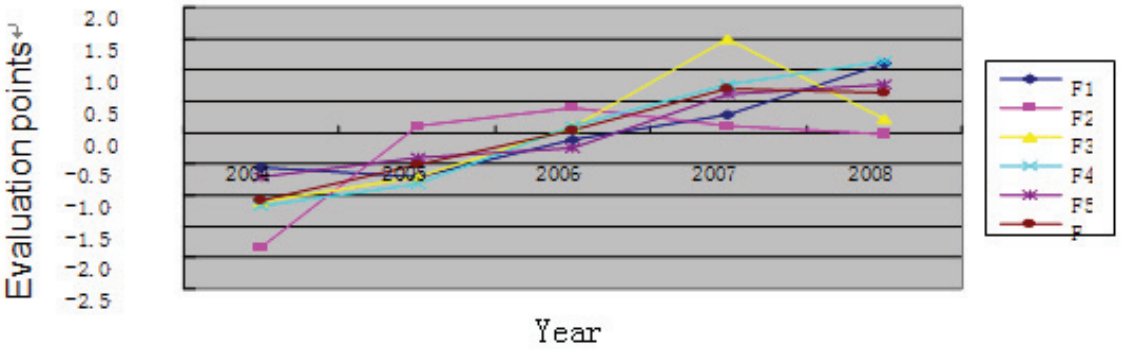


Fig.1. The systems of circular economy development trends in Shaanxi Province

Combining table 10 with chart 1, we can see that in recent years, Shaanxi province circular economy is improved gradually, which basically reflect the development status of the circular economy of Shaanxi province. In addition, through several problems exist in Shaanxi province circular economy after we did a comprehensive analysis on the indicator value and development trends

- Different indicators have different trends. The social and economic development, environmental protection, pollution abatement systems and circular economy mixed system show a stable upward trend, and resource efficiency, resource recycling and reuse show a general rising trend though some period with reduction.
- From the social and economic development level, it shows that the total economic value of Shaanxi Province is in rapid growth, but irrational industrial structure still exists, and the tertiary industry has low proportion in GDP.
- From the perspective of resource efficiency, although the GDP unit energy consumption, power consumption and energy production growth factor are relatively decreased, but not stable. This indicates that on the way of rapid economic growth, high energy consumption, high pollution is still accompanied.
- From resource recycling and reuse point of view, although the utilization of abandoned industrial solid material is gradually improving, but there is a problem that output value of products made from waste gas, waste water& solid wastes only has low proportion in GDP. This indicates that the utilization of "three abandoned material" has not much room of profit, the recycling, re-use efficiency is not high.
- For pollution reduction, although the industrial wastewater, industrial soot emissions compliance rate increased year by year, and waste treatment capacity is gradually improving, the environmental protection investment growth has hovered at a low level, it will not help the rapid development of circular economy of Shaanxi Province.
- For environmental protection, from 2004 to 2008 the per capita green area, urban domestic garbage treatment rate and urban sewage treatment rate show a relative upward trend, but unstable. The pollution emissions in consumption are keeping increasing, however the processing rate is not with the same speed of increasing.
- From circular economy mixed system point of view, the development of circular economy of Shaanxi Province is relatively stable, and growth is modest. This shows that the clean production, pollution control, waste utilization technology is relatively not mature. The clean production technology has just

started. The waste utilization and pollution control are in elementary development level and only being applied in the narrow area.

## 3. Policies and advices on accelerating the circular economy of Shaanxi

### *3.1. Changing the economy development mode and optimizing the industry economy*

To improve the level of industrialization and promote the industrial structure optimization and updating, Shaanxi province must change the economic growth mode, which means high pollution, high emission and low efficiency, to a new industrialization mode that is high-tech, rich economic returns, less resources consumption, and less pollution. What's more, it also needs to improve the competitiveness of light industry overall, upgrade the level of conventional industries' technology, and builds new advantages of light industry in Shaanxi Province. Meanwhile, it must adjust the internal structure of the tertiary industry to accelerating its development and promoting the industrial structure optimization. In order to speed up the urbanization process and ameliorate the development conditions of tertiary industry, government should be prone to invest money in order to optimize the industry economy.

### *3.2. Generalize the circular economical technology, and promoting the development of circular economy*

No matter whether the enterprises produce goods without pollution, or build industrial ecology park, even treating and recycling waste efficiently, all of them are related to the development and application of circular economy technology, such as cleaner production method, recycling technology, green remanufacturing technology, waste resource technology, and so on. All of these technologies can both improve energy use efficiency and mitigating the great pressure of the resource limitation and environmental problems. In order to solving the high energy consumption and high pollution problems in northern part of Shaanxi Province, saving nature resources, protecting and improving environment, as well as promoting the development of circular economy there, the circular economical technology should be generalized actively.

### *3.3. Optimizing the ecological environment, and improving ecological protection for the development of circular economy*

- Optimizing the rural ecological environment. To attain this aim, we need to adjust the structure of agricultural economy, and popularize ecological agriculture and organic agriculture, expand soil using for green food production, increase the types and varieties of organic food; encourage farmers to a forestation, promote the application of biogas.
- Accelerating the improvement of urban environment over all. There are several steps to achieve this aim, such as implementing the treatment of urban sewage, adding municipal sewage treatment plants, and improving the integrated system for city's waste recycling, all of which could reduce, recycle and reuse waste.

### *3.4. Enhancing propagandize, and improving social consensus*

There are still some people lacking adequate understanding of the importance of the development of circular economy. Therefore, it is necessarily to publicize ecological and circular economical knowledge widely, advocate green consumption and green lifestyle, and enhance businesses' and citizens' self-awareness and enthusiasm to protecting environment. What's more, there is also a necessity to encourage

public and citizens to participate in resource recycling and, circular economy developing, and gradually form a circular lifestyle and consumption patterns.

## 4. Conclusion

The study of circular economy theory starts up not so long ago. It has yielded some fruit, but not complete. This means it has not formed a comprehensive calculating system, which increases the difficulty for data collecting to a certain extent. In this paper, the comprehensive index system for evaluating circular economy development is constructed base on data from Shaanxi. Meanwhile, the index was used to evaluating the circular economy development of Shaanxi, which is in accordance with reality. With the circular economy development in Shaanxi Province, the statistics will be further strengthened, so that the index system will be more comprehensive and the evaluating results will be more realistic.

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