ECOLOGICAL CONSTRUCTION AND ENVIRONMENTAL MANAGEMENT IN LARGE AND MEDIUM-SIZED CITIES IN THE CONTEXT OF INDUSTRY-CITY INTEGRATION

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ABSTRACT

To maintain the ecological environment and protect the sustainable development of natural resources, this paper proposes a study on ecological construction and environmental management in large and medium-sized cities in the context of city-industry integration. The spatial layout, environmental capacity, and environmental quality are clearly deficient in the situation related to the integration of industrial and urban areas. Analyze the problems of ecological construction and environmental management in governance, construct an index system for the coordinated development of ecological and environmental systems, and measure the coupled and synergistic dispatch of cities and ecological environments. Eliminate dimensions, variable changes and values so that benefit and cost metrics are consistent. The information entropy of each index is calculated by using the original information of the objective environment, and the weights are determined after standardizing them to obtain a comprehensive index of the development level of urbanization and the ecological environment system. The coupling coordination model is used to measure two or more system linkage indicators, reflecting the degree of coordination of the interactive coupling of economic growth and the ecological environment. The analysis of the results shows that the ecological development of urbanization is steadily increasing, and the level of ecological development has grown to 0.7291 and the level of urbanization development has increased to 0.8950 over time, with a good degree of coordination of coupling.

KEYWORDS

Industry-city integration; Ecological construction; Environmental management; Coupling model; Correlation index

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1. INTRODUCTION

With the gradual advancement of China's ecological civilization construction, environmental management issues are becoming increasingly prominent. Strengthening environmental management and ensuring ecological civilization have become important strategic slogans for the economic and social development of many integrated industrial cities [1]. The key is to solve the outstanding problems of the ecological environment, improve the quality of the environment, improve the utilization rate of resources [2], and promote the harmonious development of humans and resources. In recent years, environmental management has made great progress and the Central Environmental Protection Inspectorate has achieved good results in various places [3], but there are still many problems to be solved. Only by continuously improving the level, we can make a city of ecological civilization better and better.

"The 14th Five-Year Plan period will be a period when the main and secondary contradictions in ecological environmental protection in China will be transformed, and it will be a period when the stage differences [4-5]. While further promoting development, it will become the main line of ecological civilization construction in this period to achieve ecological and environmental protection [6]. For regions with a high degree of industry-city integration, the construction of ecological civilization faces great challenges due to the high intensity of land development, high population density, large unit footprint, and high emissions [7-9].

Compared with the separation of industry and city, the integration of industry and city is a development concept proposed in the context of China's transformation and upgrading [10-11]. "Promoting cities with industries, promoting industries with cities, and integrating industries and cities" is a new idea and a new tool to solve the problem of urban functional zoning in the context of new urbanization [12-13]. National-level new districts are regional economic growth poles and new engines [14]. At the same time, it is also a specific practical exploration under the integration of industry and city. The industrial-city integration and the construction of new zones integrate industry and urbanization rationally. People-oriented and comprehensive development is an inevitable choice to adapt to the development of the times [15-16]. The management and policies of the new district should support the development strategy from the perspective of environmental construction to achieve the guidance of the blueprint and meet the needs of the healthy development of the new district with the integration of industry and city, which is an important way to implement green development [17-18].

Based on this, ecological construction and environmental management are the key objectives of concern for urban development. The literature [19] has conducted small-scale agriculture through opportunistic farming [20-23], and integration of natural landscape elements in the field [24-25]. The literature [26] discusses various modeling approaches to predict ecosystems and responses to human interventions [27], including mechanical models and so on. The literature [28] quantified the condition of

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grasslands from 2001 to 2014. The effect of SISGC on grassland conditions was estimated [29]. SISGC significantly improves grassland conditions; however, the effectiveness of SISGC is somewhat offset by other socioeconomic and climatic factors [30]. The above literature examines the relevant ecosystems or environmental management, but only one aspect is analyzed, which is not sufficiently comprehensive.

Therefore, based on the relevant data on urbanization and the ecological environment in a medium-sized city from 2011 to 2020, this paper analyzes the correlation mechanism between urbanization and the ecological environment of the city. And with the help of the coupling and coordinated development model, the coupling and coordinated scheduling of the above two indicators in the city in the past 10 years are measured, which provides a decision-making reference for ecological construction and environmental management.

2. IDEAS OF ECOLOGICAL CONSTRUCTION IN THE AREA OF CITY-INDUSTRY INTEGRATION

"China's overall economic scale will continue to expand. Industrialization, urbanization and agricultural modernization will continue to advance, and the contradiction between scale expansion and ecological environmental protection will be further highlighted [31]. As ecological environmental protection and pollution prevention enter the "deep water" area, it will be increasingly difficult and promote emission reduction in key industries. The main problems faced by the general city-industry areas are:

The spatial layout is unreasonable. The intensity of land development is close to 70%, and the early industrial development planning did not fully consider ecological and environmental protection factors. This has led to the interweaving of industrial parks and residential areas, resulting in conflicts between enterprises and groups and hidden environmental safety hazards. In addition, the proportion of industrial land is high, and the image of monotonous industrial parks is prominent. Under some regulations, the problem of sloppy utilization of industrial enterprises and use not in line with planning is more prominent.

The environmental capacity is seriously insufficient. The scale of industry is large, and the emission intensity of COD, ammonia nitrogen and volatile organic compounds per unit land area is high per unit land area. Overall, the problems of serious stock pollution, ecological cost overdraft, and environmental carrying capacity near the upper limit are more prominent. High-tech industries are the main emission sources of COD and ammonia nitrogen industries in the region [32]. "After the 13th Five-Year Plan period, the lack of alternative sources of total pollutant emission reduction has become an important bottleneck limiting industrial development.

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Environmental quality is unstable. 2019 concentrations of NO_2, PM2.5, ozone and PM10 have not yet reached secondary standards. The region will face combined PM2.5 and ozone pollution, and it will be more difficult and costly to continuously improve air quality. The rivers in the area are all used for passenger water and rely heavily on gates to control the flow of the river network. It also faces problems of poor water quality for visitors and weak self-purification of water bodies.

Key areas are in urgent need of breakthroughs. Hazardous waste disposal suffers from insufficient treatment capacity, category mismatch, low disposal and resource levels, etc. The amount of hazardous waste generated by the projects under construction has exceeded the existing disposal capacity, and there are about 6 enterprises with an annual hazardous waste volume of less than 10 tons, making it difficult to find a suitable disposal method for commissioning. The closure and relocation of key industries such as electroplating, and the redevelopment and utilization of the land left behind by enterprises and the industrial land "retreating from two to three" still need to strictly prevent environmental risks [33].

The task of supervision is complex and arduous. Environmental protection personnel in the area account for only 7% of the city's environmental protection personnel, but the per capita supervision target is about twice as large as the city's. In the new situation, environmental protection policies are getting stricter and stricter, and the requirements for personnel to supervise environmental protection are getting more and more difficult. It is difficult to cover every corner of the entire region with the existing supervision model alone.

3. ECOLOGICAL CONSTRUCTION AND ENVIRONMENTAL MANAGEMENT

3.1. THE IMPORTANCE OF ENVIRONMENTAL MANAGEMENT IN THE CONTEXT OF ECOLOGICAL CONSTRUCTION

The construction of ecological civilization is based on green development of economic and social development, taking a sustainable development path that respects nature, protects the environment and conserves resources. Environmental management refers to the use of administrative, legal, scientific and technological, educational and propaganda means to achieve the purpose of environmental protection and to realize the goal of environmental protection through planning, organizing, coordinating, controlling and supervising. Although China is vast and rich in natural resources, it is still a developing country with a large population, and there are many problems in the utilization of resources and environmental protection. Through the construction of ecological civilization, strengthening environmental management, scientific management of the environment and scientific use of

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resources, accelerating the construction of a new type of urbanization, promoting the construction of the Belt and Road.

3.2. PROBLEMS ENCOUNTERED IN ENVIRONMENTAL MANAGEMENT IN THE CONTEXT OF ECOLOGICAL CONSTRUCTION

The current urbanization process is accelerating and the urban population is increasing significantly. The contradiction between people's pursuit of material life and a quality living environment and the current waste of urban resources and poor living environment is intensifying. The low level of urban waste disposal, serious air pollution, water pollution and noise pollution exist simultaneously, which have a great impact on people's life. From the perspective of environmental management, the main problems are as follows.

1. Lack of perfect management system and management institutions

Although China has promulgated the "Ten Articles on Atmosphere" and "Ten Articles on Water". However, a more scientific, comprehensive and specific system is needed for environmental management to solve the increasingly complex environmental protection problems. In addition, our regulatory agencies are not perfect. In the face of cross-regional pollution such as river pollution and air pollution, we also lack cross-regional environmental protection agencies, the overall nature of environmental protection is not enough, and the division of authority and responsibility is not clear.

2. Public participation is too low

"The city belongs to you and me, protecting the environment depends on everyone". Although such a slogan is well known, neither the managers nor the public have done a good job. China has imperfect laws and lacks detailed regulations [34], managers are prone to slackness in their work and lack effective publicity and education for public participation. In terms of environmental protection, the quality of Chinese citizens is still relatively low. Many people still have the habit of littering and spitting, not to mention getting them to actively participate in environmental public welfare activities.

3. High cost of environmental management

In recent years, although the state has introduced fiscal and tax policies to support environmental protection and increased the financial budget for environmental protection, the funds are still far from enough compared to the current environmental protection efforts. Although some cities intend to make achievements in environmental protection, the high cost of environmental management and the lack of funds for environmental protection have led to difficulties in environmental management.

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4. THE COUPLING MECHANISM OF URBANIZATION AND ECOLOGICAL ENVIRONMENT

4.1. SETTING WEIGHTS

The coupling mechanism of urbanization and the ecological environment was analyzed in a medium-sized city as an example [35]. And the coupling and synergistic dispatch in this city were measured with the help of the coupled coordinated development model.

The basic principles of model-based index selection and formulation include scientificity, comprehensiveness and operability, and the research results are verified by evaluating the interaction between urbanization and ecological environment. According to the coupling and coordination mechanism, we combine theoretical analysis and use methods such as frequency statistics of indicators. The index systems are selected, and the evaluation indexes of the urbanization-ecological environment system are finally constructed.

Since this coefficient does not explain the raw data related to the selected indicator system, it is necessary to standardize the indicator system before quantitative analysis. To eliminate the effects of dimensionality, variables own changes and values, so that the benefit and cost indicators are consistent. First, let map X through $\min - \max$ standardized to the value in the interval $[0,1]$. The formula for this is:

$$Y_t^i = \begin{cases} x_{it} - x_{it}\min\left(x_{it}\max - x_{it}\min\right) & \text{Positive indicator normalization} \\ x_{it}\max - x_{it}/\left(x_{it}\max - x_{it}\min\right) & \text{Inverse indicator normalization} \end{cases} \quad (1)$$

In Equation (1), it is the original value of the ith index of the city, i.e., the value after data normalization. It represents the ith index of the urbanization and ecosystem index system in year t. $i = 1,2,3,4,\ldots$. Zero values may appear after data normalization. Therefore, 1 is added to the whole standardized data to make it still meaningful.

4.2. CALCULATION OF THE WEIGHT OF THE METRIC

The concept of entropy originates from thermodynamics and is a measure of the uncertainty of the system state [36]. Information is a measure of the order of an information-theoretic system. They have the property of being equal in absolute value but opposite in sign. Therefore, we can use the raw information of the objective environment. In this paper, we calculate the information entropy of each index by the entropy method, further, analyze the correlation between the indexes and determine the index weights. The entropy calculation formula with E_j as the jth index is as follows.

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$$Ej = K\sum_{i=1}^{m}\left[\left(Y_{ij}/\sum_{i=1}^{m}y_{ij}\right)\cdot\ln\left(\sum_{i=1}^{m}Y_{ij}\right)\right] \quad (2)$$

In Equation (2), K is a constant, $K = 1/1n(m)$, $E_j \in (0,1)$ that is, the maximum value of E_j is 1. Therefore, d_j can be defined as the degree of consistency of the contribution of each index system under the attribute j. $d_j = 1 - E_j$, is set as the weight value, then the weight of each index system is calculated as follows.

$$W_j = (1 - Ej)/\sum_{j=1}^{n}(1 - Ej) \quad (3)$$

The above raw index data were standardized [37] to determine the index weights. On this basis, the integrated index was calculated using the layer-by-layer weighted summation method. The calculation formula was as follows.

$$U_{1,2} = \sum_{i=1}^{m} Y_{it}^{1}\cdot W_j \quad (4)$$

In Equation (4), U_1 and U_2 denote the integrated index development level respectively.

4.3. COUPLING COORDINATION DEGREE DEVELOPMENT MODEL

4.3.1. COUPLING DEGREE ANALYSIS OF URBANIZATION SYSTEM AND ECOLOGICAL ENVIRONMENT SYSTEM

If it is set to t year, then we get U_1 and U_2 respectively, then the following functions are used for the coupling degree analysis:

$$C = 2\left[U_1U_2\right]\theta/U_1 + U_2 \quad (5)$$

In the above Equation, the coupling degree value $C[0,1]$, is set to 0.5, and the coupling degree C value is proportional to the coupling degree.

4.3.2. ANALYSIS OF THE COUPLING AND COORDINATION DEGREE MODEL OF URBANIZATION SYSTEM AND ECOLOGICAL ENVIRONMENT SYSTEM

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Because the development levels have their different degrees of difference, and the calculated weight values of both subsystems are relatively low, this paper thus introduces the model, which can better reply to the coordination degree of the interactive coupling, and the function is shown as follows:

$$\begin{cases} D = (C \cdot T)^{1/2} \\ T = \left[U_1 + U_2\right]/2 \end{cases} \quad (6)$$

The coupling degree is combined with the comprehensive development level of urbanization development and ecological environment system to calculate the coupling coordination degree of the system $D(t)$, i.e. $D(t) = (C \times T)1/2$. Where, $T = \left[U_1 + U_2\right]/2$ indicates the comprehensive development level of the urbanization system and ecological environment system in year T. The specific index division and value criteria are shown in Table 1.

Table 1. Criteria for dividing the level of coupling and coordination

D value range	Coordination level	External performance
0＜*D*≤0.3	Low coordination coupling	The development of urbanization has little impact on the ecological environment system, and the environmental carrying capacity is large
0.3＜*D*≤0.5	Moderately coordinated coupling	The level of urbanization development continues to improve, the ecological environment is gradually destroyed, and the carrying capacity of the ecological environment system becomes smaller
0.5＜*D*≤0.8	Highly coordinated coupling	The development of urbanization, the restoration of the ecological environment system
0.8＜*D*≤1	Extremely coordinated coupling	The level of urbanization development and the development of the ecological environment system have entered a stage of coordinated and orderly coupling

5. RESULTS AND ANALYSIS

We obtained the index weights by calculation based on the city's 2016, 2018, 2019 and 2020 statistical yearbooks and the city's 2011-2020 statistical bureau data. Then the city's urbanization and ecological environment development level is got by formula (4), and then its coupling coordination degree and coupling development stage is obtained by the coupling degree coordination calculation formula (6). The calculation results are in Table 2, the development trend in the past ten years is obtained as shown in Figure 1.

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Table 2. Coupling coordination degree and type from 2011 to 2020

Year	Level of urbanization U_1	Ecological environment development level U_2	Coupling coordination D	Coordination level
2011	0.0286	0.3300	0.1793	Low coordination coupling
2012	0.2294	0.3923	0.3108	Moderately coordinated coupling
2013	0.1331	0.5203	0.3267	Moderately coordinated coupling
2014	0.2474	0.3441	0.2957	Low coordination coupling
2015	0.3412	0.3673	0.3543	Moderately coordinated coupling
2016	0.4449	0.3771	0.4110	Moderately coordinated coupling
2017	0.5724	0.4271	0.4997	Moderately coordinated coupling
2018	0.7373	0.6619	0.6996	Highly coordinated coupling
2019	0.7922	0.6586	0.7254	Highly coordinated coupling
2020	0.8950	0.7291	0.8120	Extremely coordinated coupling

From the data in Table 2, we can see that the level of urbanization development in 2011 is low at 0.0286, while the level of ecological environment development is relatively high at 0.3300, and the development is unbalanced. So that the environmental carrying capacity is large, and the coupling coordination degree is 0.1793, showing a low coordination coupling stage. From 2012 to 2013, the two developed staggered. The level of urbanization continues to improve, the ecological environment is gradually destroyed, and the carrying capacity becomes smaller. The coupling coordination degrees are 0.3108 and 0.3267, respectively, showing a moderate coordination coupling stage.

And in 2014, with the rapid development of urbanization, the development of the ecological environment was hindered, so the coupling coordination degree of the two dropped to 0.2957 again, showing a low coordination coupling stage. After 2014, due to the continuous advancement of the urbanization process, including the improvement of education level, and the increase of people's awareness of environmental protection, the ecological environmental protection and governance capabilities have been greatly improved. The coupling coordination degree has also increased year by year, gradually rising from 0.3543 in 2015 to 0.7254 in 2019, indicating that the coupling stage has changed from basic advanced to high coordination, and will reach an extremely coordinated coupling stage of 0.8120 in 2020.

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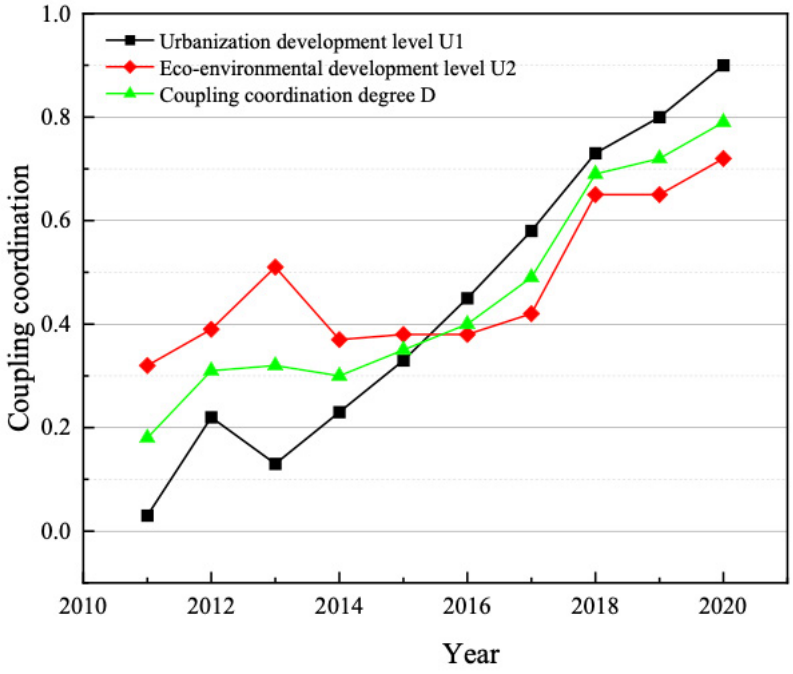

Figure 1. Development trend of coupling urbanization and ecological environment, 2011-2020

We can see from Figure 1 that the overall trend is up, except for 2013-2014, which was a declining phase; the ecological environment development level has certain fluctuations, and the overall trend is increasing. In terms of coupling coordination, the overall trend is rising, then falling and then rising. The level of ecological development of the city needs to be improved, the level of urbanization needs to be further enhanced, and the coordination between the two needs to be strengthened. In 2012, resulting in a decline in coupling, the development of urbanization was affected and showed a downward trend. After 2013, urbanization flourished, which brought certain pressure to development and made the level of development decrease. The steady growth of urbanization promotes the development of high-tech industries. From 2015 to 2017, it showed a rapid upward stage. With the continuous improvement of urbanization, the ecological environment is gradually destroyed and the carrying capacity becomes smaller, which makes the coordination degree between the two low. In general, although the urbanization construction has been continuously strengthened and environmental governance has been continuously strengthened, dialectically from the perspective of the comprehensive level, the overall ecological environment is relatively low, resulting in a low degree of coordination between the two, which is still in the Moderately coordinated coupling phase. From 2017 to 2018, due to the development of technology, the environmental governance capacity has been greatly improved, and the development level has been significantly improved.

Based on the above data, we can propose some environmental management strategies for the city. First, we suggest that the city government should strengthen the governing concept of ecological city construction and make great efforts to promote the innovation of environmental governance systems and mechanisms. It should fully coordinate the development, and insist on development in the protection and

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protection in the development. Second, improve top-level design and top-level thinking based on development ideas and the current situation of the city. Determine the overall goals, roadmap and timeline, and refine environmental goals in terms of environmental quality, environmental regulation, and public participation. To combine the research results of urban vision planning and development strategic planning, carefully compile ecological construction and environmental protection planning. Effectively maintain the authority of the plan, study and formulate annual implementation plans, clarify the responsible subjects, and strictly implement the assessment. In the implementation of ecological and environmental special planning insist on finding aspects that are difficult to achieve, especially seize the air pollution, drinking water, mountains and lakes, fumes and noise and several other outstanding issues that affect the quality of the environment and the satisfaction of the public. In the planning and implementation of the project in step-by-step arrangements to solve, to accelerate the green development in full swing, the construction of a beautiful city to provide strong support. Strengthen publicity and education, improve the public's awareness of environmental protection and law-abiding, and cultivate a good atmosphere focused on environmental credit. Consciously assume social responsibility from the legal system mandatory to the rule of law compliance, to achieve environmental pollution information disclosure, strengthen the treatment of pollution to meet emission standards, and vigorously implement clean production, through emission reduction and pollution control. Implant everyone's participation in environmental protection in the hearts of citizens and encourage public participation in ecological construction and environmental protection work. Encourage independent media coverage to further strengthen public opinion monitoring. To achieve a strong promotion of the two core elements of information disclosure and public participation in environmental governance, and to guarantee residents' right to informed environmental supervision.

6. DISCUSSION

In the context of urbanization, the integration of industry and cities has greater power and thus positive and negative effects. One must limit the negative effects of industry on the integration of industry and cities. One of the key measures is to promote industry-city integration based on ecological construction. While promoting industry-city integration, ecological construction should be promoted and environmental management systems should be strengthened. To make the speed, scale and intensity of industry-city integration adapt to the evolutionary process of ecological environment carrying capacity and ensure that the development of industrial and urban integration is always within the ecological environment appendix value. Integrating population, resources and environment, promoting the integration of industry-city and ecological civilization, and realizing the respective functions and overall functions are the keys to the integration of industry-city and ecological civilization. Make the integration of industry and city and ecological civilization

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construction promote each other, and promote and coordinate each other in time, function and development speed.

7. CONCLUSION

Building an ecological city and optimizing the environmental governance system is to meet the people's demand to have a better life. It is an objective requirement to promote the construction of ecological civilization by the law and a strategic need to achieve sustainable development under the new normal. This paper further analyzes how to carry out reasonable environmental management based on the construction of an ecological construction system of a city in the context of industry-city integration. To provide a reference and the optimization of the environmental governance system in the region.

1. The urbanization development of the city has been greatly improved. Except for the period from 2012 to 2013 when the urbanization development level decreased due to the decrease in the proportion of industrial output value, the urbanization development level in general tends to be in a stable and increasing stage in the last ten years, from 0.0286 in 2011 to 0.8950 in 2020.

2. Except from 2013 to 2014, when the level of ecological and environmental development decreased due to the smaller carrying capacity of the ecosystem, the level of ecological and environmental development, in general, tends to be a stable and increasing stage in the last decade, from 0.3300 in 2011 to 0.7291 in 2020.

3. From this urban and ecological environment coupling development degree curve we can see that the urbanization development level, and ecological environment development level in Xiangyang city are all in the rising stage during 2011-2013. During the period 2013-2014, the level of urbanization development of the city has increased and its ecological development level has decreased, while the coupled development degree of the two is in a decreasing stage. During the period 2014-2020, all three of them are again in an increasing stage.

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