Scholar Publishing Group
Nature Environmental Protection
https://doi.org/10.38007/NEP.2022.030103
ISSN 2790-2684 Vol. 3, Issue 1: 18-25

Harmonization of Urban Development and Nature Conservation Environment Based on Machine Learning

Jiwei Zhang*

Gansu Industry Polytechnic College, Gansu, China

635479027@qq.com

**corresponding author*

Keywords: Machine Learning, Urban Development, Protection of the Environment, Coordinated Development

Abstract: A good environment can provide material security for urban development, facilitate the efficient use of energy resources, and attract large amounts of investment, bring technological innovation, and thus promote the pace of urbanization. On the contrary, a bad ecological environment restricts the development of urbanization, and the image, development speed, construction scale, investment environment and resource supply of cities are affected. The purpose of this paper is to study the coordinated development of urban development and nature conservation environment based on machine learning. The ecological city theory and the kinds of machine learning algorithms are analyzed. Among the mutual constraints of urbanization and ecological environment studied by using gray correlation matrix as well as coordination degree, the experimental results show that the unreasonable industrial structure is an important factor causing serious industrial pollution in M city.

1. Introduction

Urbanization has led to a large influx of rural laborers into cities, rapid growth of urban economy, and expansion of urban space, which in turn has led to a sharp increase in demand for urban water resources, such as excessive consumption of resources and energy, over-centralized exploitation and over-exploitation of water, and loss of natural landscape. At the same time, urbanization has also caused many problems in the ecological environment of cities and their surroundings, such as the increase of total production and domestic waste discharge, water pollution, destruction of ecological vegetation, sharp decrease of biodiversity, and intensification of urban heat island effect [1, 2]. In addition, the highly dense population, traffic congestion, and tight housing in cities also bring many inconveniences to the urban living environment. Unhealthy economic development paths and urbanization paths have long been the main cause of increased ecological pressure. However, urbanization does not always have a negative impact, but also has a positive effect [3, 4]. Most

ecological and environmental problems are caused by human misuse of resources, and urbanization can reduce regional ecological and environmental pressures by controlling the human-day layout.

The process of urbanization makes the industrial layout more concentrated, the level of science and technology improves, and the resources are recycled efficiently, which can make all kinds of pollution be solved centrally and the ecological environment damage be controlled effectively [5].Sara Reed discussed the impact of sewage treatment on urban environment and its significance to urban environmental protection based on the current situation of urban sewage treatment. At the same time, she put forward some suggestions to improve urban wastewater treatment capacity, which laid a solid foundation for urbanization and urban development [6]. With the increasing efficiency of wastewater treatment, the production of sewage sludge has been increasing. If improperly treated, the sludge with heavy metals and other toxic and harmful substances will inevitably cause secondary pollution.Nivesh Gadipudi, through a field survey of Wenzhou city, illustrates the current situation and effectiveness of the environmental management of urban sludge in Wenzhou city, and analyzes the problems and dilemmas in the environmental treatment of urban sludge in China. Finally, the development prospect of urban sludge treatment industry in China is predicted from four aspects [7]. Therefore, it is of practical significance to study the coordinated development of urban development and nature conservation environment based on machine learning.

In this paper, the ecological city theory is used as the theoretical support for the coordinated development, and it is found that there is an interactive coupling relationship between urbanization process. And further, the gray correlation matrix is calculated by using the gray correlation degree analysis method, and the coordination and mutual constraints in the middle stage of urbanization in M city are analyzed in detail, which provides a theoretical basis and practical suggestions for the coordinated development in M city.

2. Research on the Coordination of Urban Development and Nature Conservation Environment Based on Machine Learning

2.1. Ecological City Theory

The overall guiding principle of economic development of "ecological city" is the basic, conceptual guideline for the economic development of a coordinated system of urbanization and ecological environment [8, 9]. When formulating the urbanization development strategy of a region, it is necessary to ensure its coordinated development with the ecological environment, following the principles of high efficiency and low consumption of economic activities; the principle of people-oriented industrial development; the principle of comprehensive discounting of social and environmental costs; the principle of systemic economic structure; and the indirect principle of operational mechanisms [10, 11]. It is possible to get twice the result with half the effort, emphasizing how economic development at the same time allows to achieve comprehensive use of the environment and resources and sustainable development, proposing the right way to evaluate the effectiveness of urbanization, the success of the urbanization process cannot be based on the success of economic development alone, it is necessary to evaluate whether the development of the environment and society in the urbanization process has kept up with the development of economicization and whether it has been destroyed because of economic development [12, 13].

2.2. Machine Learning Algorithms

Machine learning is the use of computer computing to simulate human learning behavior. Machine learning did not emerge to replace traditional methods of statistical learning; rather, it is an

extension of statistics [14, 15]. Regression analysis is mainly used for prediction, inferring the output value corresponding to it from the training set. In order to properly classify and regression analyze data, machine learning has developed four forms of learning during its development [16].

(1) Supervised learning:A model is inferred from labeled training data, and this model can map new instances and predict the results by this model when new data are incorporated [17].

(2)Unsupervised learning:The class of sample data is unknown, so it is necessary to find the regularity in the data set and classify the sample set based on the similarity between samples.

(3)Semi-supervised learning:Semi-supervised learning combines a large amount of unlabeled data [18].

(4) Reinforcement learning:The knowledge is continuously updated so as to improve the original solution to make the most benefit obtained.

3. Investigation and Research on the Coordination of Urban Development and Nature Conservation Environment Based on Machine Learning

3.1. Study Area

City M is located in the south-central part of the country, and its territory spans two major geomorphological units, the Taihang Mountains and the North China Plain. It now has 6 districts, 5 county-level cities and 12 counties, with a total area of 15,848 square kilometers. In this paper, the original data were collected from the statistical bulletin of M city from 2001 to 2010. This paper uses SPSS16.0 software to conduct Pearson's correlation coefficient test and bilateral significance test on the standardized raw data of two systems, and eliminate the repetitive indicators.

3.2. Construction of Comprehensive Evaluation Index System of Urbanization and Ecological Environment

In this paper, 10 integrated indicators reflecting urbanization were selected from four aspects: population urbanization, economic urbanization, spatial urbanization, and social urbanization, as shown in Figure 1. From three aspects of ecological environment level, ecological environment pressure and ecological environment protection, 10 indicators are selected to reflect ecological environment status comprehensively.

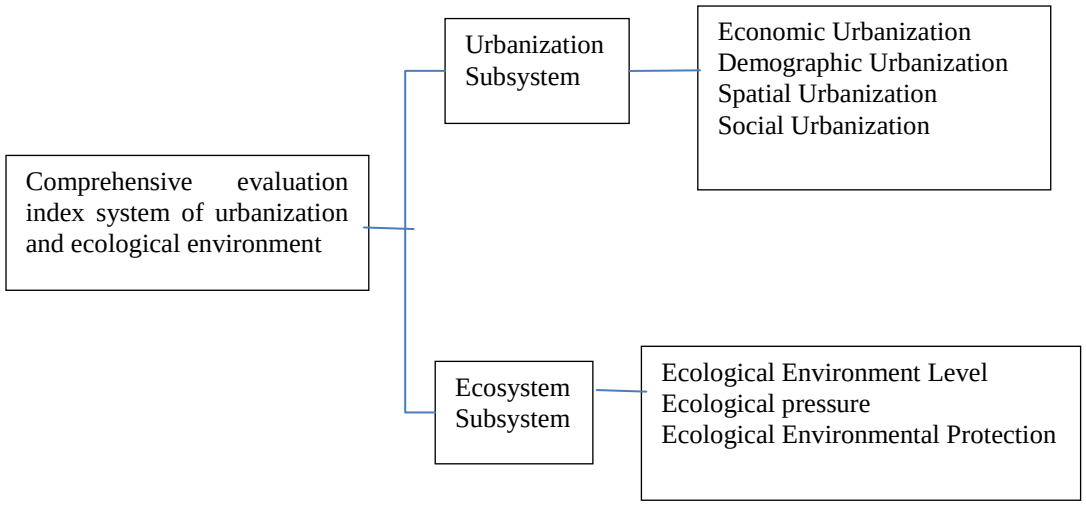

Figure 1. Indicator system

3.3. Gray Correlation Analysis Method

In order to facilitate revealing the basic relationship and laws of synchronization between urbanization and ecological environment in M city, the correlation model in M city is constructed according to the basic indicators of urbanization.

$$\xi_i(j)(t)=\frac{\min\limits_i\min\limits_j\left|z_i^x(t)-z_j^y(t)\right|+\rho\max\limits_i\max\limits_j\left|z_i^x(t)-z_j^y(t)\right|}{\left|z_i^x(t)-z_j^y(t)\right|+\rho\max\limits_i\max\limits_j\left|z_i^x(t)-z_j^y(t)\right|} \tag{1}$$

where ρ is the standardization coefficient, generally taking a value of 0.5; $\xi_i(j)(t)$ is the number of correlation coefficients at moment t.

The average correlation coefficient of k sample size yields the m × l correlation matrix γ, which reflects the complex relationship between urbanization coupling and ecological environment:

$$\gamma=\begin{vmatrix}\gamma_{11}\cdots\gamma_{1j}\cdots\gamma_{1l}\\ \cdots\\ \gamma_{i1}\cdots\gamma_{ij}\cdots\gamma_{il}\\ \cdots\\ \gamma_{m1}\cdots\gamma_{mj}\cdots\gamma_{ml}\end{vmatrix} \tag{2}$$

In the obtained gray correlation matrix, by comparing the magnitude of each correlation degree γij, we can analyze the factors in the ecosystem that are closely related to the development of urbanization.

3.4. Degree of Coordination

The degree of coordination is a quantitative indicator of the degree of coordination between systems or elements. Regarding the coordination evaluation of the economic-environmental system, the coordination between two systems is mainly considered, and the coordination of the economic-environmental system over a period of time is analyzed by calculating the coordination between two systems. The pursuit of coordinated development is a good prospect of common progress, comprehensive improvement, overall optimization and common development. Therefore, in the economic aspect, we hope that f(x)g(y) with the smaller the gap, preferably expressed by the coefficient of variation, i.e., we hope that :

$$C_r=\frac{s}{\frac{1}{2}[f'(x)+g'(y)]}=\sqrt{2\left\{1-\frac{f'(x)+g'(y)}{[\frac{f'(x)+g'(y)}{2}]^2}\right\}} \tag{3}$$

The smaller the Cr, the better (s is the standard deviation). Construct the coordination degree calculation model:

$$C=\left\{1-\frac{f'(x)+g'(y)}{[\frac{f'(x)+g'(y)}{2}]^2}\right\}^k \tag{4}$$

C is the degree of coordination and k represents the adjustment system.

4. Analysis and Research on the Coordination of Urban Development and Nature Conservation Environment Based on Machine Learning

4.1. Discriminating the Coordination

The specific measurement steps of urbanization and ecological environment in M city are as follows:According to the gray correlation degree model, the raw data in M city in 2010-2010 after standardization are calculated by the formula, and the mutual correlation coefficients between the indicators of urbanization and ecological environment in M city are obtained, and the correlation degree matrix of each indicator is obtained after merging and organizing. Then the calculated correlation coefficients of each indicator for each year were started to get the size of urbanization and ecological environment coordination degree and the change of coordination degree in M city from 2018 to 2022, specifically Table 1 and Figure 2. the change of urbanization and ecological environment in each year was analyzed from the perspective of time series, and the stage characteristics and reasons of the development role of urbanization and ecological environment in M city were revealed more clearly.

Table 1. 2018-2022 Urbanization and ecological coordination in city m

Year	Coherence
2018	0.82
2019	0.77
2020	0.61
2021	0.68
2022	0.69

As can be seen from Table 1, the coordination degree in M city during 2018-2022 is basically maintained between 0.61 and 0.77, except for 2018 when the coordination degree is 0.82, which is in a strong coordination state, and the coordination degree in M city in the rest of the years is basically maintained between 0.61 and 0.77, which is a medium coordination according to the quantitative evaluation standard of urbanization and ecological environment correlation degree. It indicates that in recent years, there are mutual constraints between the urbanization process and environment, which undermine the coordination degree between them.

4.2. Analysis of Industrial Emissions

The degree of coordination in City M during 2021-2022 is significantly higher than that in 2020, as shown in Table 2. This is mainly due to the fact that environmental management has a certain lagging effect. With the continuous improvement of science and technology, the utility of technological emission reduction is gradually revealed. in 2022, the compliance rate of industrial wastewater discharge in city M is 95%, which is 7% higher than that in 2020; the comprehensive utilization rate of industrial solid waste gas material also increases from 91% in 2020 to 97% in

2022. The industrial wastewater emissions per 10,000 Yuan and industrial waste gas emissions per 10,000 Yuan have decreased significantly, as shown in Table 3 and Figure 2.

Table 2. Indicators of three waste management in M city

Year	Industrial wastewater discharge compliance rate (%)	Comprehensive utilization rate of industrial solid waste (%)
2020	88	91
2021	92	93
2022	95	97

Table 3. Industrial waste gas emissions in 2020-2022

Year	Industrial wastewater emissions of 10，000 yuan (tons per million yuan)	10，000 yuan industrial waste gas emissions (million standard cubic meters / million yuan)
2020	5.62	0.56
2021	4.88	0.44
2022	3.14	0.31

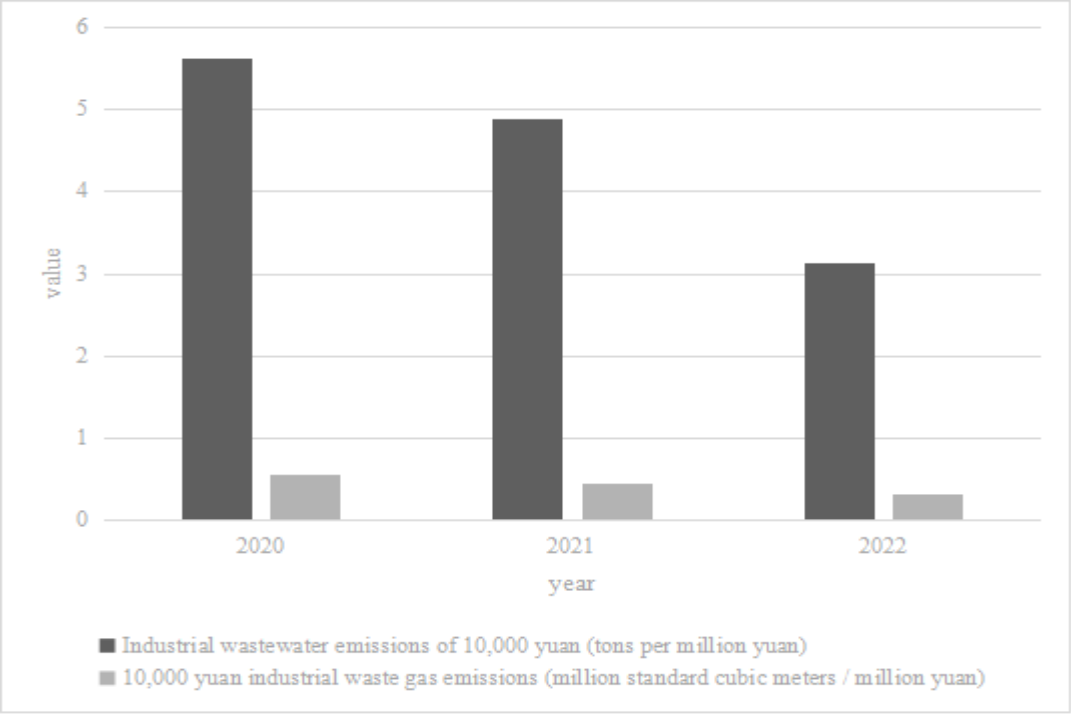

Figure 2. Industrial waste gas emissions in city M

Although M city has tried its best to improve in recent years, some pollution problems are still growing here and there and have not been completely eradicated, so as shown in the figure, urbanization and ecological environment in M city show a fluctuating rise, so it is necessary to take a holistic view and plan systematically in M city.

5. Conclusion

At present, there are mature theories and methods in the field of studying the relationship between urbanization and ecological environment, but these methods have some limitations, and to a certain extent, they are not suitable for comparative and integrated analysis of different cities on a large scale. Of course, there are some shortcomings in the research process of this paper. In the data processing of indicators, most of the benchmark and ideal values are chosen as the minimum and maximum values, which are not the most suitable benchmark and ideal values, and the results obtained cannot obviously show the individual differences. Also, the definition of urbanization and ecological coordination in this paper is defined from the perspective of personal understanding plus practical starting point, which has a greater influence on the results. The scale of current research is already wide, but it is all about individual cities or urban clusters, and a breakthrough in the method that can evaluate the whole should be sought.

Funding

This article is not supported by any foundation.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

References

[1] Hirokazu Yamakura, Gilbert Siy Ching, Yukiko Kishiki, Noboru Sekino, Ichiro Oshima, Tetsuro Imai. Measurement and Ray Tracing Simulation with Urban Microcell Environments at 28GHz Band. IEICE Trans. Commun. (2022) 105-B(6): 748-756. https://doi.org/10.1587/transcom.2021ISP0006

[2] Byungjae Park. Stochastic Path Optimization to Improve Navigation Safety in Urban Environment. IEICE Trans. Inf. Syst. (2022) 105-D(5): 1116-1119. https://doi.org/10.1587/transinf.2021EDL8069

[3] Nassim Sadallah, Sa ïd Yahiaoui, Ahc ène Bendjoudi, Nadia Nouali-Taboudjemat. Multi-objective Offline and Online Path Planning for UAVs under Dynamic Urban Environment. Int. J. Intell. Robotics Appl. (2022) 6(1): 119-138. https://doi.org/10.1007/s41315-021-00195-y

[4] Rafael Diaz, Canh Phan, Daniel Golenbock, Benjamin Sanford. A Prescriptive Framework to Support Express Delivery Supply Chain Expansions in Highly Urbanized Environments. Ind. Manag. Data Syst. (2022) 122(7): 1707-1737. https://doi.org/10.1108/IMDS-02-2022-0076

[5] Vanessa Vasquez, V ctor Cruz, Mar a Mendez, Irma Solis, Francisco Aguilar, Mario Chauca. Characterization and Evaluation of the Visual Impact of Mobile Communication Base Stations in the Urban Environment. J. Commun. (2022) 17(4): 239-249. https://doi.org/10.12720/jcm.17.4.239-249

[6] Sara Reed, Ann Melissa Campbell, Barrett W. Thomas. The Value of Autonomous Vehicles for

Last-Mile Deliveries in Urban Environments. Manag. Sci. (2022) 68(1): 280-299. https:/doi.org/10.1287/mnsc.2020.3917

[7] Nivesh Gadipudi, Irraivan Elamvazuthi, Cheng-Kai Lu, Sivajothi Paramasivam, Steven W. Su. Lightweight Spatial Attentive Network for Vehicular Visual Odometry Estimation in Urban Environments. Neural Comput. Appl. (2022) 34(21): 18823-18836. https://doi.org/10.1007/s00521-022-07484-y

[8] Teymur Azayev, Karel Zimmermann. Autonomous State-Based Flipper Control for Articulated Tracked Robots in Urban Environments. IEEE Robotics Autom. Lett. (2022) 7(3): 7794-7801. https://doi.org/10.1109/LRA.2022.3185762

[9] Nesreen I. Ziedan. MAI Modeling and Mitigation for GNSS Acquisition in Urban Environments. IEEE Trans. Aerosp. Electron. Syst. (2022) 58(1): 541-551. https://doi.org/10.1109/TAES.2021.3103250

[10] Patrick Alrassy, Jinwoo Jang, Andrew W Smyth. OBD-Data-Assisted Cost-Based Map-Matching Algorithm for Low-Sampled Telematics Data in Urban Environments. IEEE Trans. Intell. Transp. Syst. (2022) 23(8): 12094-12107. https://doi.org/10.1109/TITS.2021.3109851

[11] Giseop Kim, Sunwook Choi, Ayoung Kim. Scan Context++: Structural Place Recognition Robust to Rotation and Lateral Variations in Urban Environments. IEEE Trans. Robotics. (2022) 38(3): 1856-1874. https://doi.org/10.1109/TRO.2021.3116424

[12] Nadia Yoza-Mitsuishi, Christopher Robert Anderson, Peter Mathys. Propagation Model Analysis for 7- and 13-GHz Spectrum Sharing in Urban Environments. IEEE Wirel. Commun. Lett. (2022) 11(9): 1965-1969. https://doi.org/10.1109/LWC.2022.3189691

[13] Suresh Dara, Swetha Dhamercherla, Surender Singh Jadav, Ch Madhu Babu, Mohamed Jawed Ahsan. Machine Learning in Drug Discovery: A Review. Artif. Intell. Rev. (2022) 55(3): 1947-1999. https://doi.org/10.1007/s10462-021-10058-4

[14] Leandro Miranda, José Viterbo, Flávia Bernardini. A Survey on the Use of Machine Learning Methods in Context-Aware Middlewares for Human Activity Recognition. Artif. Intell. Rev. (2022) 55(4): 3369-3400. https://doi.org/10.1007/s10462-021-10094-0

[15] Muhammad Waqas, Shanshan Tu, Zahid Halim, Sadaqat ur Rehman, Ghulam Abbas, Ziaul Haq Abbas. The Role of Artificial Intelligence and Machine Learning in Wireless Networks Security: Principle, Practice and Challenges. Artif. Intell. Rev. (2022) 55(7): 5215-5261. https://doi.org/10.1007/s10462-022-10143-2

[16] Simon Penny. Review of Art in the Age of Machine Learning by Sofian Audry. Artif. Life. (2022) 28(1): 167-169. https://doi.org/10.1162/artl_r_00352

[17] Dieudonné Tchuente, Serge Nyawa. Real Estate Price Estimation in French Cities Using Geocoding and Machine Learning. Ann. Oper. (2022) Res. 308(1): 571-608. https://doi.org/10.1007/s10479-021-03932-5

[18] Ibrahim Yazici, Ömer Faruk Beyca, Omer Faruk Gurcan, Halil Zaim, Dursun Delen, Selim Zaim. A Comparative Analysis of Machine Learning Techniques and Fuzzy Analytic Hierarchy Process to Determine the Tacit Knowledge Criteria. Ann. Oper. Res. (2022) 308(1): 753-776. https://doi.org/10.1007/s10479-020-03697-3