Journal of Engineering, Project, and Production Management
2026, 16(7), 2025-314

Coupling Coordination and Co-Evolution between Rural Tourism and New Urbanization

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Project Management
Received December 10, 2025; revised January 28, 2026; accepted July 7, 2026
Available online July 20, 2026

Abstract: Taking Qiandongnan Prefecture, Guizhou Province, as a case study, the study constructed an evaluation index system encompassing both rural tourism and new urbanization. The co-evolutionary path between 2013 and 2022 was quantitatively analyzed. The study found that the coupling coordination between rural tourism and new urbanization in Qiandongnan Prefecture showed a significant trend of improvement during the study period. The coupling coordination Degree (D) increased from 0.4138 in 2013 to 0.8359 in 2022, representing a significant transition from near-disharmony to high-level coordination. The development type shifted from "lagging rural tourism" to "lagging new urbanization" after 2016. Grey correlation analysis results indicated that transportation network density (correlation: 0.9413), per capita Gross Domestic Product (correlation: 0.9188), and tourism fixed asset investment (correlation: 0.8936) were the core drivers of the two's coordinated development. This research deepened the theoretical understanding of urban-rural interactions in ethnic minority areas and could provide a practical reference for formulating precise policies for urban-rural integration and sustainable development in these regions.

Keywords: Rural tourism; New urbanization; coupling coordination; ethnic minority areas; Qiandongnan Prefecture.

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DOI 10.32738/JEPPM-2025-314

1. Introduction

In China's modernization, urban-rural interplay is core. The new era's rural revitalization and people-centered New Urbanization (NU) drive regional Coordinated Development (Co-Dev). Rural Tourism (RT), which links urban and rural areas and transforms ecological and cultural values, boosts rural development. NU emphasizes two-way factor flow via industrial support and public service equalization. Ethnic minority areas, with unique resources and underdeveloped foundations, are key to both strategies. Using RT to activate these areas potential and synergize with NU is theoretically and practically significant.

In the field of RT, to systematically evaluate its development, Karali et al. (2024) found, through a bibliometric analysis, that RT research grew rapidly over the past two decades and that developing countries showed great research potential. Wu et al. (2025) addressed the issue of RT-urbanization coupling using multiple data types and entropy methods, and evaluated models to analyze urban agglomerations in the Yellow River Basin from 2000 to 2020, revealing trends such as polarization and establishing a basin-scale coupling coordination framework. Focusing on industrial innovation, Madanaguli et al. (2022) constructed an innovation ecosystem model for RT through a systematic review, filling the theoretical gap in this sub-sector. At the practical level, Chan (2023) revealed the multidimensional connotation, driving factors and improvement paths of sustainable practices through qualitative interviews with RT operators. Meanwhile, research on NU has become increasingly in-depth. For example, Yang et al. (2023) used the double-difference method to confirm that NU construction could significantly promote the economic expansion of resource-dependent cities by refining resource allocation and advancing industrial transformation.

More importantly, numerous research endeavors have begun employing coupling-coordination models to examine the intricate, interactive relationships among tourism, urbanization and other human and environmental systems. For example, Zhang et al. (2023) used the Panel Vector Autoregression (PVAR) model to confirm a dynamic response between urban tourism development and the human living environment, and that the Coupling Coordination Degree (CCD) has steadily increased. Li et al. (2025) addressed the issue of CCD by breaking with the traditional research paradigm. They measured the high-quality development and ecosystem service value of 292 Chinese cities from 2000 to 2021, constructed a CCD model, revealed its characteristics, including changes, and classified the cities into four categories. Some studies focused on its environmental effects. For example, Raihan et al. (2022) suggested that urbanization and tourism development had a positive influence on Brazil's carbon emissions. Voukkali et al. (2024) also pointed out the challenges of seasonal tourism activities to urban solid waste management. This method was also widely used for more complex system-coupling analysis. Hou et al. (2022) explored the coordination relationship between the three major systems of economy, ecology and health, and found that health was a key factor. Wang et al. (2022) evaluated the coupling relationship between urbanization and ecological resilience and found that the two exhibited a trend from basic coordination to basic imbalance in the Pearl River Delta region. The quantitative evaluation method for CCD was also continually evolving. Even in relatively different fields, such as Zou et al. (2022), which addresses the quantitative evaluation of coal and coalbed methane co-mining, they also constructed a coupling coordination model grounded in the Bayesian principle. Yousaf et al. (2025) addressed issues related to tourism development in ethnic minority areas and spatial development in China. Using a qualitative case study approach, they conducted 25 interviews and conducted in-depth, iterative analysis in a She ethnic township in Zhejiang Province, revealing three key findings regarding the evolution of the She ethnic social and cultural identity.

However, existing research often overlooks ethnic regions as a distinct category and relies on static measures, failing to capture their dynamic evolution and internal driving mechanisms. To bridge these gaps, this study proposes a comprehensive framework that combines temporal evolution, spatial differentiation, and driving factors. Taking Qiandongnan Prefecture, a representative ethnic region, as a case study, the research quantitatively analyzes the long-term coupling dynamics and uncovers the core driving factors, aiming to provide precise policy references for urban-rural integration in ethnic areas.

2. Theoretical Analysis and Research Hypotheses

2.1. Definition of Core Concepts

The coupling mechanism and the stage-evolution framework for the Co-Dev of RT and NU in ethnic regions are presented in Fig. 1.

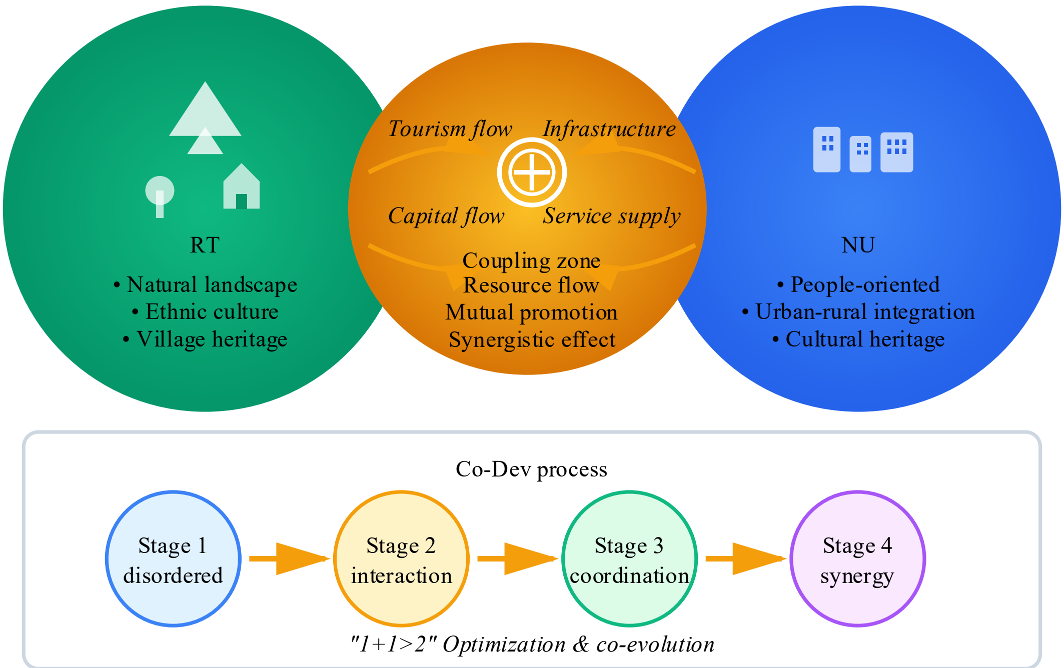


Fig. 1. Coupling mechanism and stage evolution framework of Co-Dev of RT and NU in ethnic regions

As shown in Fig. 1, "coupling" originates in physics, denoting mutual influence between systems, and, in socioeconomic contexts, describes the strength of their connection. Coupling and Co-Dev are dynamic, benign processes. Here, it refers to RT and NU systems in ethnic minority areas interacting interdependently through people, goods, capital, and information flows, evolving from disorder to order toward "1+1>2" symbiosis.

2.2 Analysis on Interactive Mechanism of Co-Dev of RT and Urbanization

RT and NU in ethnic minority areas are not two isolated systems. Instead, they form an organic whole that interacts with and supports one another through the flow of factors, industrial linkages, and spatial reconstruction. The interactive mechanism of their Co-Dev can be understood as a dynamic cycle process of "from point to surface, two-way drive." The four-stage interaction and circular feedback mechanism of RT and urbanization is shown in Fig. 2.

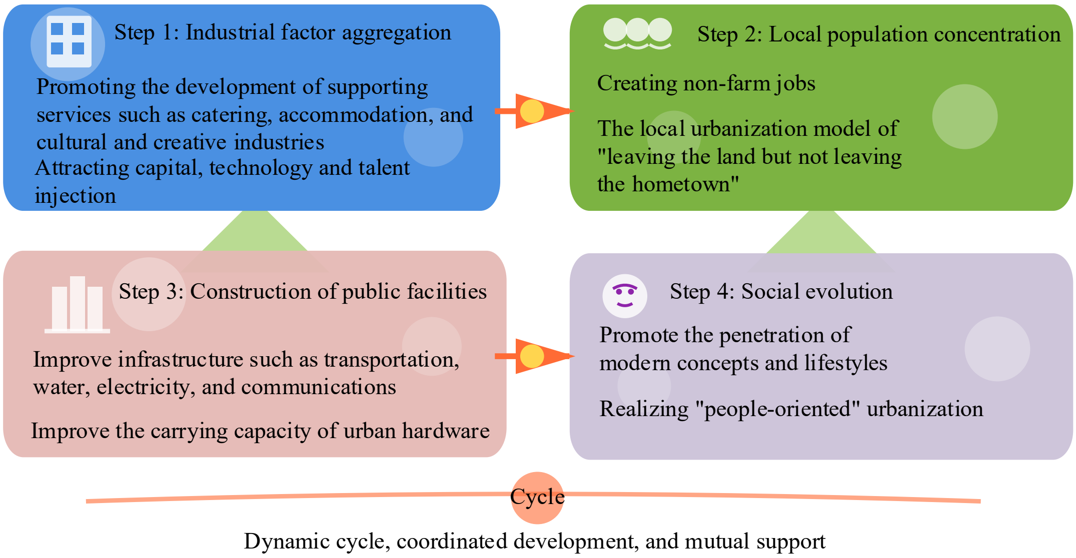


Fig. 2. Interactive and circular feedback mechanism between RT and urbanization in four stages

As shown in Fig. 2, the interaction forms a closed loop. RT stimulates urbanization through industrial agglomeration and population retention ("bottom-up"), while urbanization supports RT via capital, infrastructure, and market demand ("top-down").

2.3. Research Hypothesis

Based on the theoretical analysis of the interaction mechanisms, this study proposes three hypotheses:

H1: The comprehensive development levels of both RT and NU will show an overall upward trend, driven by the dual implementation of rural revitalization and urbanization strategies. H2: The coupling coordination between the two systems will continuously improve. The mutual feedback mechanism ensures positive interaction, though periodic imbalances (e.g., lagging development) may occur due to differing speeds. H3: The CCD exhibits significant spatial heterogeneity. Due to variations in resource endowments and transportation, the coordination level is expected to form 'hot spots' in central areas and 'cold spots' in remote regions.

3. Area Selection and Research Approaches

3.1. Overview and Selection of Research Areas

The determination of the research domain serves as the foundation for empirical analysis. Its typicality, representativeness and data availability are directly related to the scientific nature and universality of the research conclusions. Based on the theme of "Co-Dev of RT and urbanization in ethnic minority areas", it is essential to select a spatial sample with rich ethnic cultural resources, rapid RT momentum, distinct urbanization characteristics and significant interaction between the two. After comprehensive research and analysis, the study ultimately focused on the Qiandongnan Miao and Dong Autonomous Prefecture in Guizhou Province, as shown in Fig. 3.

(a) Guizhou Qiandongnan long range (b) Guizhou Qiandongnan close up

Fig. 3. Qiandongnan Miao and Dong Autonomous Prefecture, Guizhou Province

Qiandongnan (prefecture-level) boasts a complete, continuous socio-economic statistical system. Data from its Statistical Yearbook, government bulletins and cultural-tourism department support indicator construction and econometric tests, guaranteeing research feasibility and scientific soundness.

3.2. Index System Construction and Data Sources

Guided by the principles of scientific rigor and feasibility, this study constructs an evaluation framework comprising two subsystems: 'RT development' (encompassing industrial scale, resource base, and service support) and 'NU' (covering population, economy, society, and ecology). The specific indicators and their measurements are detailed in Tables 1 and 2. The research period spans from 2013 to 2022, with data primarily derived from the Qiandongnan Statistical Yearbook, Guizhou Provincial Statistical Yearbook, and relevant government bulletins. Individual missing values were interpolated using the mean or trend extrapolation methods to ensure data integrity.

3.3. Research Methods

To objectively determine the contribution of each indicator, the Entropy Weight Method (EWM) was employed to calculate the weights after range normalization. All indicators constructed in this study are benefit-oriented (i.e., the larger the indicator value, the more positive the contribution to the system's level of development). Therefore, a forward standardization formula is used uniformly to address directional issues. This standardization process maps all indicator values to the [0, 1] interval, yielding dimensionless data. First, range normalization is used to standardize the original data. Different processing methods are used for the directionality of the indicators, as shown in Eq. (1).

$$\begin{cases} Y_{ij} = \frac{X_{ij} - min(X_j)}{max(X_j) - min(X_j)} & (\text{Beneficial indicator}) \\ Y_{ij} = \frac{max(X_j) - X_{ij}}{max(X_j) - min(X_j)} & (\text{Cost indicator}) \end{cases} \tag{1}$$

In Eq. (1), X_{ij} represents the raw data and Y_{ij} denotes the standardized value. Based on the normalized values, the proportion of the i-th sample under the j-th indicator (P_{ij}) and the information entropy $(E_j)$are calculated, as shown in Eq. (2).

$$P_{ij} = \frac{Y_{ij}}{\sum_{i=1}^{n} Y_{ij}}, \quad E_j = -\frac{1}{ln\, n}\sum_{i=1}^{n} P_{ij}\, ln\, P_{ij} \tag{2}$$

Finally, the information redundancy $(D_j = 1 - E_j)$ is determined to derive the objective weight (W_j) for each indicator, as shown in Eq. (3).

$$W_j = \frac{D_j}{\sum_{j=1}^{m} D_j} \tag{3}$$

The specific calculation steps follow the standard procedure described in previous studies. The coupling degree (CD) C reflects the degree of interaction and mutual influence between the two systems, as shown in Eq. (4).

$$C = 2 \times \left[\frac{U_1 \times U_2}{(U_1 + U_2)^2}\right]^{\frac{1}{2}} \tag{4}$$

In Eq. (4), Crepresents the CD; U_1 and U_2 denote the comprehensive development indices of the RT subsystem and the NU subsystem, respectively. The value of C ranges from 0 to 1, where a value closer to 1 indicates a stronger interaction between the two systems.

$$\begin{cases} D = \sqrt{C \times T} \\ T = \alpha U_1 + \beta U_2 \end{cases} \tag{5}$$

In Eq. (5), D denotes the CCD; T represents the comprehensive coordination index, reflecting the overall synergy level of the two systems; and α and β are the contribution coefficients of RT and NU, respectively. Assuming both subsystems are equally important, the values are set as $\alpha = \beta = 0.5$.

4. Empirical Outcomes and Analysis

4.1. Development Level and Evolution of Two Major Subsystems

The missing indicators and their missing rates during the empirical process are summarized in Table 1.

Table 1. Summary of missing indicators and missing rates

Subsystem	RT	Missing rate (%)
RT	TTR	20
	Tourism revenue as a percentage of GDP	10
	Number of star-rated hotels	10
	Number of travel agencies	10
NU	Urban population density	10
	The proportion of output value of secondary and tertiary industries	10
	Hospital beds per 10,000 people	10
	per capita urban road area	10
	Green coverage rate of built-up areas	10
	Harmless treatment rate of domestic waste	10

As shown in Table 1, all missing data were from a single year, with no consecutive missing data. The highest missing rate did not exceed 20%, which met the requirements for reasonable panel data processing. To assess the robustness of the CCD results to the imputation method, mean imputation and linear interpolation were compared. The CCD comparison results for key years are shown in Table 2.

Table 2. Comparison of CCD values for key years

Years	Mean interpolation	Linear interpolation	Absolute difference	Coefficient of variation (%)
2013	0.4138	0.4145	0.0007	0.17
2016	0.5942	0.5951	0.0009	0.15
2020	0.7303	0.7312	0.0009	0.12
2022	0.8359	0.8366	0.0007	0.08

As shown in Table 2, the absolute difference in CCD values between the two interpolation methods was less than 0.001, the coefficient of variation was less than 0.2%, and the trends were completely consistent, indicating that the research results were robust and not affected by the interpolation method. Table 3 shows the objective weights of the evaluation indicators (EIs) for the RT subsystem, calculated employing the EWM.

Table 3. Weights of the RT subsystem EIs

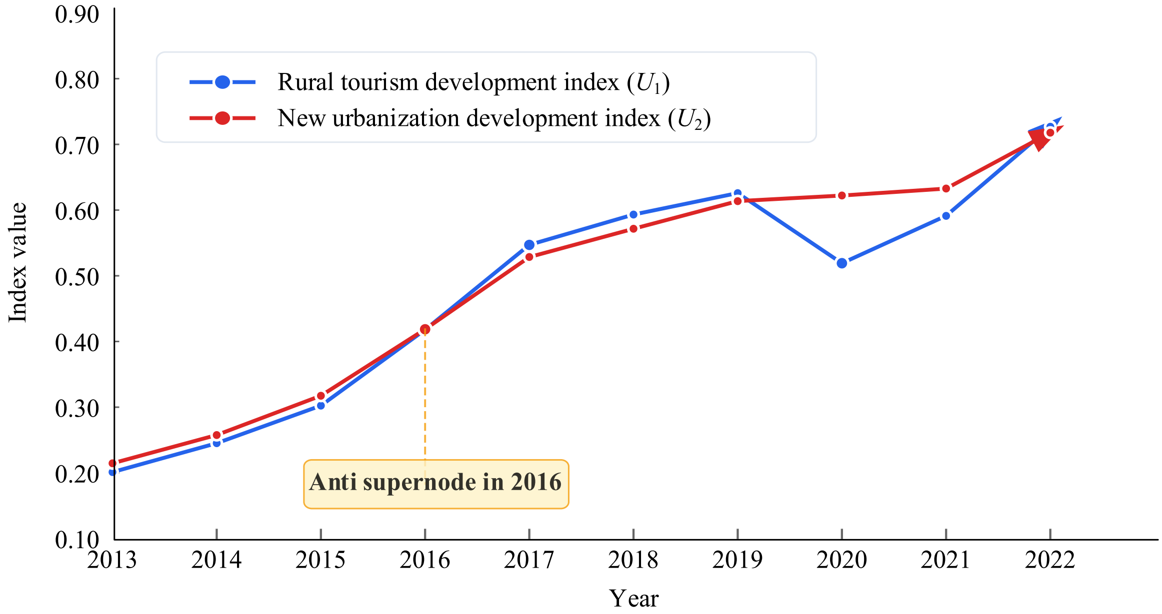
Dimension	Indicator	Weight
Industrial scale and benefit (0.4133)	TTR	0.1821
	Total tourist arrivals	0.1243
	Share of TTR in GDP	0.1069
Resource foundation (0.3479)	Number of A-level scenic spots	0.1588
	Number of star-rated hotels	0.1124
	Number of intangible cultural heritage items	0.0767
Service support (0.2388)	Highway mileage	0.1312
	Number of travel agencies	0.1076
Total	/	1

As shown in the calculation results in Table 3, the two criteria layers, "Industrial scale and benefit" and "Resource foundation," had high weights. Among them, "TTR" (weight 0.1821) and "Number of A-level scenic spots" (weight 0.1588) were core indicators for measuring the level of regional RT development, indicating that economic output and the supply of high-quality tourism resources were the key drivers of RT development in Qiandongnan Prefecture. Table 4 presents the weights of various EIs for the NU subsystem.

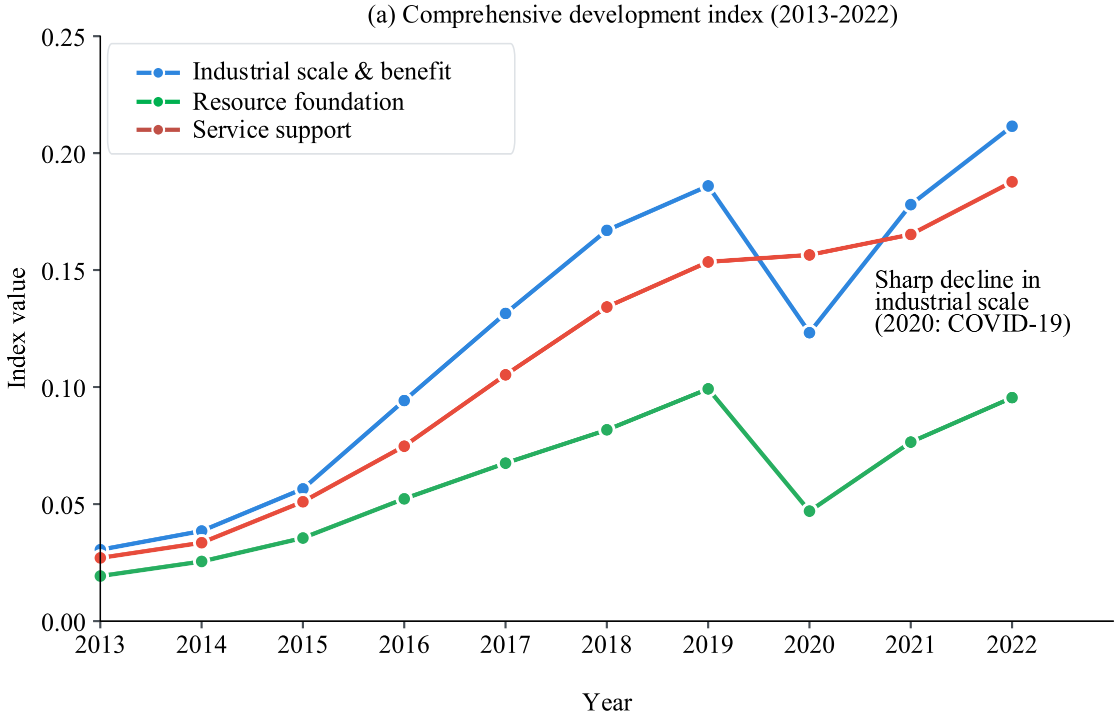
Table 4. Weights of the new-type urbanization subsystem EIs

Dimension	Indicator	Weight
Population urbanization (0.1643)	Urbanization rate of permanent population	0.0911
	Urban population density	0.0732
Economic urbanization (0.3412)	Per capita GDP	0.1258
	Share of STI	0.1183
	Per capita retail sales of consumer goods	0.0971
Social urbanization (0.3129)	Hospital beds per 10,000 people	0.0954
	Students per 10,000 people	0.0838
	Per capita urban road area	0.0722
	Internet penetration rate	0.0615
Ecological urbanization (0.1816)	GCR of built-up areas	0.0689
	Harmless disposal rate of domestic waste	0.0624
	Per capita park green area	0.0503
Total	/	1

As shown in Table 4, "economic urbanization" (weight 0.3412) and "social urbanization" (weight 0.3129) were the most important dimensions for evaluating the quality of NU in Qiandongnan Prefecture. Among the specific indicators, "per capita GDP" had the highest weight (0.1258), followed by "proportion of secondary and tertiary industry output value" (0.1183). This indicated that economic growth and the optimization of the industrial structure were the core drivers of the region's urbanization. The comprehensive development index is shown in Fig. 4.



(a) Comprehensive development index (2013-2022)



(b) Evolution of rural tourism subsystem dimensions (2013-2022)

Fig. 4. Evolution of the comprehensive development index and RT subsystem dimensions (2013-2022)

Fig. 4(a) shows that the development levels of both systems showed a significant upward trend, indicating overall positive development over the past decade. During the initial phases of development (2013-2015), the NU development index (U2) was slightly higher than the RT development index (U1). In 2016, RT experienced rapid growth; its development index surpassed NU's for the first time. Fig. 4(b) shows the "Evolution of various dimensions of the RT subsystem (2013-2022)." To further explore the internal driving structures behind the evolution of the two systems' comprehensive indices, Table 5 calculates the annual development sub-indices for each criterion layer (dimension) within the RT and NU systems.

Table 5 shows that the decline in the RT system in 2020 was primarily due to a sharp drop in the "Industry scale and benefit" dimension (from 0.2982 to 0.1977), while its "Resource foundation" and "Service support" dimensions maintained resilient growth. For the NU system, "Population urbanization" was the core driver of growth, with its sub-index increasing from 0.0719 to 0.2281 and contributing the majority of the growth.

4.2. Dynamic Evolution of Coupling Coordination Relationships

After constructing the annual composite indices for the two subsystems, the study further assessed the intensity and synergy of their interactions using the CD (C) and CCD (D). C focuses on whether the systems interact strongly, while D comprehensively reflects whether the interactions have shifted from strong to strong, from quantitative change to qualitative change. Given that the sample period encompassed intensive policy implementation and external shocks, the following table summarizes the C and D calculation results from 2013 to 2022, allowing observation of long-term trends and periodic fluctuations, as presented in Table 6.

Table 5. Evolution of development sub-indices for each dimension

Year	Industrial scale and benefit	Resource foundation	Service support	Population urbanization
2013	0.0488	0.0431	0.0309	0.0342
2014	0.0617	0.0539	0.0407	0.0388
2015	0.0903	0.0811	0.0567	0.0459
2016	0.1512	0.1198	0.0839	0.0571
2017	0.2104	0.1683	0.1085	0.0683
2018	0.2677	0.2149	0.1307	0.0754
2019	0.2982	0.2451	0.1585	0.0831
2020	0.1977	0.2503	0.0756	0.0872
2021	0.2849	0.2818	0.1224	0.0931
2022	0.3396	0.3207	0.1531	0.0998

Table 6. Calculation outcomes of CD (C) and CCD (D), 2013-2022

Year	CD (C)	CCD (D)
2013	0.9634	0.4138
2014	0.9798	0.4489
2015	0.9912	0.5052
2016	0.9999	0.5942
2017	0.9984	0.6706
2018	0.9946	0.7337
2019	0.9881	0.7824
2020	0.9996	0.7303
2021	0.9928	0.7969
2022	0.9837	0.8359

As shown in Table 6, the CD (C) consistently remained above 0.88. The CCD (D) rose from 0.4138 (on the verge of disharmony) in 2013 to 0.8359 (well-coordinated) in 2022. This demonstrated a healthy and positive overall development trend. Table 7 provides a qualitative interpretation of the coupling-coordination results.

As shown in Table 7, the system was on the verge of disharmony from 2013 to 2014, characterized by a "lagging RT" pattern. From 2015 to 2016, it entered a stage of barely Co-Dev. Since 2017, the system has entered a stage of Co-Dev, reaching intermediate or higher levels. Especially after 2016, the development pattern shifted to a "lagging NU" pattern, reflecting a structural shift in the driving force of development. The trend charts for the CCD D and CD C are shown in Fig. 5.

The broken line in Fig. 5 represents the CD (C), which remained consistently above 0.96 throughout the study period, indicating a strong interaction and correlation between the two systems and laying a solid foundation for their Co-Dev. The bars in the Fig. represent the CCD (D), which showed a steady upward trend, rising from 0.4138 (a level close to disharmony) in 2013 to 0.8359 (a level of good coordination) in 2022. This clearly demonstrated that, although the interaction intensity (CD) between the two systems was consistently high, it took nearly a decade for the quality and level of their development (coupling coordination) to gradually improve from the initial run-in stage and ultimately enter a healthy and efficient collaborative development track.

Table 7. Annual classification of coupling-coordination level and type

Year	CCD (D)	Coordination level	Development type (U1 vs U2)
2013	0.4138	On the verge of imbalance	RT lagging
2014	0.4489	On the verge of imbalance	RT lagging
2015	0.5052	Barely coordinated	RT lagging
2016	0.5942	Barely coordinated	Synchronous development
2017	0.6706	Primary coordination	UrbanizatION LAGGing
2018	0.7337	Intermediate coordination (IC)	Urbanization lagging
2019	0.7824	IC	Urbanization lagging
2020	0.7303	IC	RT lagging
2021	0.7969	IC	Urbanization lagging
2022	0.8359	Good coordination	Urbanization lagging

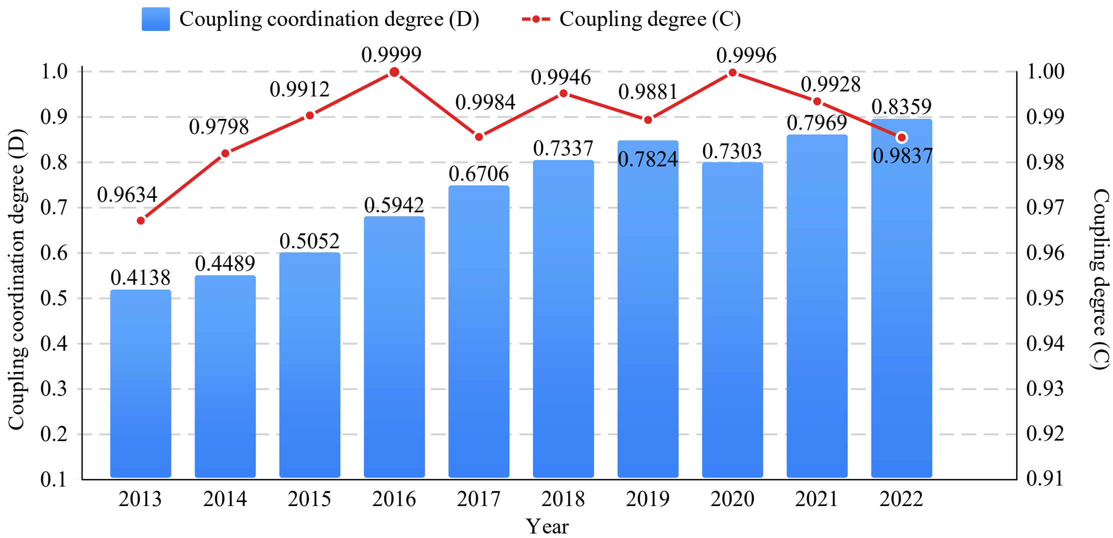


Fig. 5. Trend of CCD D and CD C

4.3 Spatial Pattern of Coupling Coordination Relationship

Beyond overall evolution, spatial variation is an important dimension for understanding coordination quality. To this end, representative counties (cities) within the prefecture were selected for comparison, with D values and coordination levels at the beginning and end of the study period compared to identify distinct pathways and gradient patterns, such as "gateway-type distribution center, resource-rich area, latecomer catch-up zone." To explore intra-regional variation, Table 8 compares the coupling coordination levels of selected counties (cities) in Qiandongnan Prefecture at the beginning and end of the study period.

Table 8. Spatial comparison of CCD in major counties (cities) of Qiandongnan Prefecture (2013 vs 2022)

County (city)	CCD (D) in 2013	CCD (D) in 2022	Coordination level (2022)
Kaili City	0.5218	0.8814	Good coordination
Leishan County	0.3811	0.8523	Good coordination
Liping County	0.4026	0.8178	Good coordination
Danzhai County	0.4374	0.8031	Good coordination
Congjiang County	0.3189	0.7249	Intermediate coordination
Rongjiang County	0.3542	0.7586	Intermediate coordination

To present the spatial differentiation characteristics of coordinated development in Qiandongnan Prefecture, six representative counties (cities) were selected based on differences in administrative level, resource endowment, geographical location, and development level. The sample covered the prefectural capital's administrative core (Kaili City), core tourism resource areas (Leishan, Liping, and Danzhai Counties), and peripheral development areas (Congjiang and

Rongjiang Counties), balancing typicality and diversity. Qiandongnan Prefecture comprises 16 counties and cities; not all were included in the sample to avoid data redundancy and focus on core spatial patterns. The data in Table 8 showed that coordination levels improved significantly across all counties and cities, but with substantial spatial variation. Kaili, the provincial capital, consistently maintained a high level of coordination. Leishan County, leveraging its core scenic area, saw the largest improvement in coordination, jumping from 0.3811 to 0.8523. While Congjiang County, a relatively peripheral county, made significant progress, its level of coordination still lagged behind that of other counties and cities, demonstrating a "core-periphery" spatial pattern. Based on the Guizhou map, a simple spatial variation chart of the CCD evolution in Guizhou Province was constructed, as shown in Fig. 6.

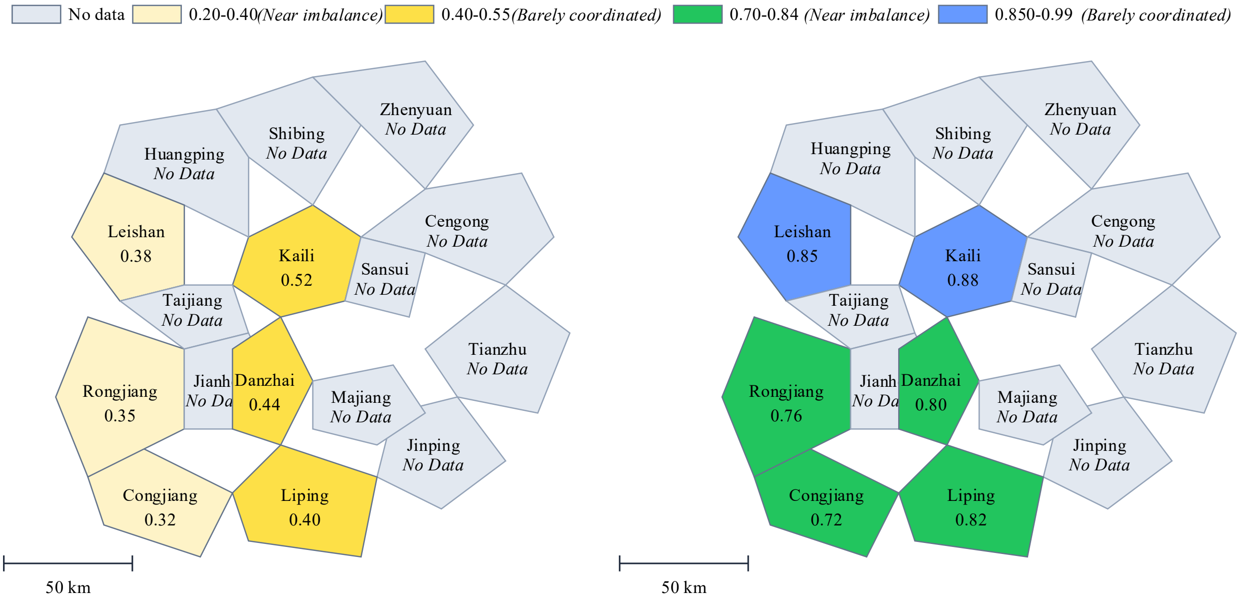


Fig. 6. Evolution diagram of spatial differentiation of CCD

Fig. 6 illustrates the significant spatial evolution from 2013 to 20221. In 2013, coordination was generally low. Kaili City was the sole growth pole (0.52), while most regions lagged, ranging from 0.32 to 0.442. By 2022, the pattern had undergone comprehensive optimization, achieving a minimum CCD of 0.723. Kaili (0.88) consolidated its lead, while Leishan (0.85) and Liping (0.82) emerged as new cores, forming a contiguous high-level coordination cluster with the surrounding four counties.

5. Discussion

Empirical results revealed the dynamic, optimized coupling coordination between RT and NU in Qiandongnan. CCD jumped from near-disharmony to good coordination in a decade, validating the "two-way driving" mechanism-RT is an endogenous engine for ethnic regions. This conclusion was consistent with the research of Lu and Li (2024), who also confirmed that the integration of agriculture and tourism could effectively promote the on-site urbanization of rural residents through evidence analysis of 1,868 counties in China.

The study’s key finding was the 2016 shift from "RT lag" to "NU lag" in ethnic regions: early urbanization enabled RT, whose explosive growth outpaced urban support, a common trend in fast-developing tourist destinations. For instance, the study by Perles-Ribes et al. (2025) warned that “explosive tourism growth” could lead to insufficient infrastructure and service supply, thus triggering unsustainable development risks.

In terms of spatial pattern, the “core-periphery” structure identified in the study, that is, the phenomenon of highly coordinated “hotspots” with the provincial capital Kaili City and the core scenic area Leishan County as the location, was a typical manifestation of the “growth pole” theory in regional economics. For example, the study by Benedek et al. (2022) evaluated how growth pole policies led to spatial inequality, while Graziano and Ruggiero (2023) explored how tourism served as a growth pole in peripheral areas. The study's findings provided empirical evidence from ethnic regions in China, indicating that regions with administrative center status or top tourism resource endowments were more likely to be the first to achieve a virtuous cycle between the two systems.

Finally, the analysis of driving factors-transportation network density, per capita GDP and tourism investment ranked in the top three, once again emphasizing the decisive role of “channel + capital” in the catch-up

development of lagging regions. In particular, the overwhelming importance of transportation infrastructure aligned closely with the conclusions of numerous studies emphasizing accessibility. For example, research by Jangra et al. (2024) confirmed the crucial role of transportation in developing high-altitude tourist destinations, while Arbidane et al. (2023) also emphasized the importance of accessibility in achieving "tourism for all." This has particularly profound policy implications for ethnic regions with complex terrain and relatively remote locations.

6. Conclusion

Set against the backdrop of the deep integration of rural revitalization and NU strategies, this study, using Qiandongnan Prefecture in Guizhou Province as a case study, empirically tested the Co-Dev mechanisms of RT and urbanization from 2013 to 2022, employing models such as the CCD. The study found that the development levels of both systems improved significantly, with RT surpassing RT to become the dominant force in 2016, but experiencing a brief decline in 2020 due to external shocks. The coupling coordination relationship between the two achieved a qualitative leap, with the CCD (D) rising from 0.4138 (on the verge of disharmony) in 2013 to 0.8359 (well-coordinated) in 2022, significantly improving development quality. Spatially, a clear "core-periphery" pattern emerged. In 2022, the coordination degree of Kaili City, the prefecture capital, reached 0.8814, while that of Congjiang County, a more remote area, was 0.7249. Furthermore, resource-rich regions, such as Leishan County, showed strong catching-up momentum (increasing from 0.3811 to 0.8523). Analysis of driving factors indicated that transportation network density (correlation: 0.9413) was the primary driver, with economic level and investment also playing key roles. The analytical framework and core conclusions of this study offered valuable insights for regions with similar situations globally. The methodology developed in the study, and the interactive mechanism revealed that where RT stimulated endogenous growth and urbanization provided fundamental support, could be applied to other regions with distinctive cultural or ecological resources but relatively weak development foundations. In practical application, it was necessary to consider local conditions, focus on key drivers such as transportation, capital, and core resources, and be wary of coordination risks arising from mismatched development speeds. However, this research still faces limitations, such as a relatively macroscopic scale and a lack of in-depth causal analysis. Future work could explore the use of more microscopic panel data and qualitative research methods, as well as comparative studies across diverse ethnic regions, to achieve more universal conclusions.

Funding

This research received no specific financial support from any funding agency.

Institutional Review Board Statement

Not applicable.

Declaration of Artificial Intelligence (AI) Tools

The author used AI tools solely for language editing and to improve readability. The author reviewed and verified all content and takes full responsibility for the accuracy and integrity of the manuscript.

References

Arbidane, I., Puzule, A., Znotina, D., Narkuniene, R., and Daubariene, J. (2023). Accessibility and smart tourism: tourism for all and reducing inequalities: a tourism agenda 2030. *Worldwide Hospitality and Tourism Themes,* 15(5), 497–506. doi: 10.1108/WHATT-06-2023-0078

Benedek, J., Cosmina-Daniela, U., and Ştefana, V. (2022). Growth pole policy's induced development and spatial inequalities in the metropolitan areas of Romania—a critical assessment. *Tér és Társadalom,* 36(3), 47–67. doi: 10.17649/TET.36.3.3435

Chan, J. K. L. (2023). Sustainable rural tourism practices from the local tourism stakeholders' perspectives. *Global Business and Finance Review (GBFR)*, 28(3), 136–149. doi: 10.17549/gbfr.2023.28.3.136

Graziano, T. and Ruggiero, L. (2023). From periphery to growth pole (and back again?): late industrialism, smart strategies and tourism in south-eastern Sicily. *Regional Studies, Regional Science,* 10(1), 89–105. doi: 10.1080/21681376.2023.2168211

Hou, C., Chen, H., and Long, R. (2022). Coupling and coordination of China's economy, ecological environment and health from a green production perspective. *International Journal of Environmental Science and Technology,* 19(5), 4087–4106. doi: 10.1007/s13762-021-03329-8

Jangra, R., Kaushik, S. P., Singh, E., Kumar, P., and Jangra, P. (2024). The role of transportation in developing the tourism sector at high altitude destination, Kinnaur. *Environment, Development and Sustainability,* 26(4), 9369–9395. doi: 10.1007/s10668-023-03099-y

Karali, A., Das, S., and Roy, H. (2024). Forty years of the rural tourism research: Reviewing the trend, pattern and future agenda. *Tourism Recreation Research*, 49(1), 173–200. doi: 10.1080/02508281.2021.1961065

Li, Z., Ye, Y., Liu, X., and Wu, Q. (2025). Research on the coupling coordination, spatiotemporal evolution and zoning management of high-quality development and ecosystem service value in China. *Scientific Reports*, 15(1), 12665. doi:10.1038/s41598-025-96627-x

Lu, J. and Li, H. (2024). Effect of agriculture–tourism integration on in situ urbanization of rural residents: evidence from 1868 counties in China. *China Agricultural Economic Review,* 16(1), 135–153. doi: 10.1108/CAER-08-2022-0191

Madanaguli, A., Kaur, P., Mazzoleni, A., and Dhir, A. (2022). The innovation ecosystem in rural tourism and hospitality–a systematic review of innovation in rural tourism. *Journal of Knowledge Management,* 26(7), 1732–1762. doi: 10.1108/JKM-01-2021-0050

Perles-Ribes, J. F., Moreno-Izquierdo, L., Más-Ferrando, A., Rubia, A., and Núñez Romero, M. (2025). Methodological proposal to determine explosive tourism growth: a warning for unsustainable development? *Current Issues in Tourism,* 28(12), 1982–2000. doi: 10.1080/13683500.2024.2360693

Raihan, A. and Tuspekova, A. (2022). Dynamic impacts of economic growth, energy use, urbanization, tourism, agricultural value-added, and forested area on carbon dioxide emissions in Brazil. *Journal of Environmental Studies and Sciences,* 12(4), 794–814. doi: 10.1007/s13412-022-00782-w

Voukkali, I., Papamichael, I., Loizia, P., and Zorpas, A. A. (2024). Urbanization and solid waste production: prospects and challenges. *Environmental Science and Pollution Research,* 31(12), 17678–17689. doi: 10.1007/s11356-023-27670-2

Wang, S., Cui, Z., Lin, J., Xie, J., and Su, K. (2022). The coupling relationship between urbanization and ecological resilience in the Pearl River Delta. *Journal of Geographical Sciences,* 32(1), 44–64. doi: 10.1007/s11442-022-1935-3

Wu, K., Xing, A., Wei, G., Xin, H., Wei, Y., Su, L., and Zhou, J. (2025). Evaluation of coupling coordination degree between tourism urbanization and ecosystem services in urban agglomerations in the yellow river basin. *Scientific Reports*, 15(1), 22427. doi:10.1038/s41598-025-05455-6

Yang, Z., Cao, Y., and Du, J. (2023). The impact of new urbanization construction on sustainable economic growth of resource-based cities. *Environmental Science and Pollution Research,* 30(43), 96860–96874. doi: 10.1007/s11356-023-29171-8

Yousaf, S., Liu, Y., and Xiang, Y. (2025). Tourism and sociocultural identity discourses in ethnic minority communities: a study of the ethnic townships in Zhejiang Province, China. *Journal of Sustainable Tourism*, 33(7), 1348-1372. doi:10.1080/09669582.2024.2347544

Zhang, Y., Haseeb, M., Hossain, M. E., Hu, M., and Li, Z. (2023). Study on the coupling and coordination degree between urban tourism development and habitat environment in the Yangtze River Delta in China. *Environmental Science and Pollution Research,* 30(6), 14805–14820. doi: 10.1007/s11356-022-23135-0

Zou, Q., Chen, Z., Cheng, Z., Liang, Y., Xu, W., Wen, P., Zhang, B., Liu, H., and Kong, F. (2022). Evaluation and intelligent deployment of coal and coalbed methane coupling coordinated exploitation based on Bayesian network and cuckoo search. International *Journal of Mining Science and Technology*, 32(6), 1315–1328. doi: 10.1016/j.ijmst.2022.11.002

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