sustainability

MDPI

Article

Study on the Matching Degree between Land Resources Carrying Capacity and Industrial Development in Main Cities of Xinjiang, China

Yu Liu [1], Fangchen Shi [2,*], Hongman He [2], Liyin Shen [2], Wenzhu Luo [2] and Lingyun Sun [3]

1 School of Architecture and Urban Planning, Chongqing University, Chongqing 400045, China; cqdxly2012@163.com
2 School of Management Sicence and Real Estate, Chongqing University, Chongqing 400045, China; hehongman-ircsbe@foxmail.com (H.H.); shenliyincqu@163.com (L.S.); 20150302045@cqu.edu.cn (W.L.)
3 Xinjiang Branch of Chongqing, University General Institute of Architectural Planning and Design, Urumqi 30000, China; sunlingyun0920@163.com
* Correspondence: Shi_Fangchen@163.com

Abstract: The contradiction between industrial development (ID) and land resource carrying capacity (LRCC) is increasingly intensified with the rapid advancement of urbanization globally. This typical phenomenon exists particularly in these developing countries or regions. This study investigated the matching degree (MD) between ID and LRCC by using a coupling coordination degree model (CCDM) with referring to the main cities of Xinjiang, China. The data used in this study was collected from 16 sample cities in Xinjiang for the period of 2009–2018. The research findings reveal that (1) MD average value between 16 sample cities has been gaining steady growth; (2) although MD value in all sample cities has been increasing, there still exists a big room for improvement towards a well matching state; (3) the differences in MD values among all sample cities are very small; (4) the MD performance in the northern cities in Xinjiang is better than that in southern Xinjiang. This is mainly because of the radiation effect of Urumqi in northern cities. It is therefore suggested developing such a radiation city in southern Xinjiang in order to improve MD performance in southern Xinjiang. These research findings can provide policymakers in Xinjiang and other backward cities globally with valuable references in understanding the status of MD between ID and LRCC in the local cities, thus tailor-made policy instruments can be designated for the mission of sustainable development.

Keywords: sustainable development; urbanization; land resource carrying capacity (LRCC); industry development (ID); matching degree (MD); case study

check for updates

Citation: Liu, Y.; Shi, F.; He, H.; Shen, L.; Luo, W.; Sun, L. Study on the Matching Degree between Land Resources Carrying Capacity and Industrial Development in Main Cities of Xinjiang, China. *Sustainability* **2021**, *13*, 10568. https://doi.org/10.3390/su131910568

Academic Editors: Mary Hardie and Liyaning (Maggie) Tang

Received: 6 August 2021
Accepted: 16 September 2021
Published: 23 September 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

Land is regarded as the most basic factor of production for supporting industrial development (ID) [1–3]. The supporting effect of land use on ID is manifested in both "quantity support" and "structural support", that is, the amount of land (area) is the cornerstone of ID, and the change of land use structure will lead to the corresponding adjustment of industrial structure [4]. However, with the rapid advancement of urbanization, the contradiction between ID and LRCC is increasingly intensified. For example, in the process of urbanization, the rapid development of industries and the explosive growth of population has caused excessive consumption of land resources, resulting in serious resource constraints and environmental pollution problems, such as the sharp reduction of arable land, soil pollution, traffic congestion, and so on. These problems limit the economic development of a city and hinder the process of sustainable development of a city.

It is worth noting that this contradictory phenomenon is particularly serious in areas with weak resource endowment and underdeveloped economies, such as cities in Xinjiang, China. According to data from the Ministry of Land and Resources, the average urban land

GDP index of Xinjiang was 1.532 million RMB in 2017, which is only 22.1%, 16.7%, and 36.5% of that recorded in Beijing, Shanghai, and Guangzhou, respectively [5]. However, as the strategic fulcrum of China's "One Belt and One Road" and "Global community with a shared future", the development of Xinjiang's urban industry and economy has increasingly become an important cornerstone of national rejuvenation and social stability [6]. Xinjiang's land area accounts for one-sixth of China's [7], which means that if ID and LRCC can develop coordinately, it will promote the coordinated development between ID and LRCC throughout China. Therefore, the Chinese government pays great attention to the ID of Xinjiang and the coordination between ID and LRCC in the region. For example, according to the document of the Healthy Development of industry in Xinjiang issued by the National Development and Reform Commission in 2014, the government put great emphasis on the coordinated development of ID and LRCC of Xinjiang.

It can be seen that it is urgent to determine solutions that can enable the coordinated development between ID and LRCC in the underdeveloped cities of Xinjiang. Therefore, the study on the matching of ID and LRCC of cities in Xinjiang not only helps to promote the implementation of the major strategy of the Western development of China, but also provides guidance and reference for the sustainable development of backward border areas of Xinjiang. Furthermore, understanding matching between ID and LRCC is of great significance to regional planning and promotes the sustainable development of Xinjiang. Thus, research on the matching between ID and LRCC in Xinjiang is conducive to identify the weak matching areas, and then adequate policies can be formulated to increase the matching between ID and LRCC in Xinjiang.

Previous studies have presented various findings on ID and LRCC. The relevant research can be categorized into three groups. The first category mainly focuses on the study of ID under the constraint or support of LRCC, which mainly involves three aspects, namely, industrial scale, industrial layout, industrial structure. From the perspective of industrial scale, Millington and Millington (1973) investigated the scale of the food industry supported by Australia's LRCC, and suggested that the maximum population size should be capped at 12 million if the standard of living of Australia is maintained at a high standard [8]. Gu et al. (2010) investigated the scale of leading industries based on the constraint of LRCC and pointed out that the appropriate industrial scale of coal mining and washing industry of Pingbao area of Henan City in China should be 39.7 billion RMB to 45.8 billion RMB in 2015 [9]. In the research on industrial layout, Guangmin (1999) studied the characteristics and historical development of land resources in Macao and considered that the industrial layout in Macao should be dominated by gambling tourism and trade service industry [10]. In referring to LRCC, Li et al. (2017) suggested that the industrial spatial pattern of Qingyang City in Gansu City in China should be dominated by energy and chemical industry in the central part of the city, industry, and agriculture in the south, and agriculture and animal husbandry in the southwest [11]. In examining industrial structure under the support of LRCC, Mendia et al. (2017) studied the status of ID from the perspective of LRCC support in Newcun, Argentina, and pointed out that it is necessary to combine the geological conditions and the differentiated characteristics of ecological resources in different areas of the city [12]. Niu et al. (2020) studied the appropriateness of the industrial structure of Tibet from the perspective of LRCC and found that the land resources severely restricted the development of Tibet's industry [13].

The second group of research in the discipline of ID and LRCC mainly focuses on the impact of ID on LRCC. For example, Cheng et al. (2017) constructed an evaluation index system of LRCC in China's major grain-producing areas (Heilongjiang City) and concluded that the risk factors of the LRCC system are mainly industrial structure and regional economic development [14]. Gray et al. (2018) analyzed the interrelationship between LRCC and industrial structure in Queensland, Australia, and concluded that the development of agriculture, industry, and mining has exerted varying degrees of pressure on the local LRCC [15]. In referring to 11 cities in the Harbin-Changchun urban agglomeration for the period of 2004–2015, Tang et al. (2021) investigated the index of the

ID, urban construction, social economy, suggesting that only the two cities of Harbin and Changchun present satisfactory LRCC state in the agglomeration [16].

A further group of research in the discipline of ID and LRCC focuses on the correlation and coordination between ID and LRCC. For example, Yang et al. (2020) analyzed the correlation and coordination between the LRCC and the industrial structure in referring to Zhengzhou by using the grey relational analysis model and concluded that the industrial structure of the city was unreasonable during 1998–2017 [17]. Xie et al. (2013) evaluated the coupling level of LRCC and ID in Poyang Lake Eco-economic Zone in China, and concluded that the simultaneous optimization of land resources and the economy is the best way to improve the coupling between LRCC and ID [18]. In examining the evolution of urban LRCC, in referring to 290 prefecture-level cities in China, Luo et al. (2020) suggested that the proportion of high-tech industrial land should be increased in the process of industrial transfer in these cities in order to improve urban LRCC [19].

From the above literature review, it can be seen that there are few studies on the relationship between ID and LRCC, and there is almost no research examining the match between ID and LRCC in referring to main cities in Xingjiang. Further, existing studies mainly focus on certain aspects of ID such as industrial structure and industrial scale but overlook the issue of more comprehensive aspects. This way could not provide an overall and comprehensive understanding of the matching relationship between ID and LRCC. Therefore, this article is dedicated to providing an index evaluation system related to studying the matching between ID and LRCC in the main cities of Xinjiang in China.

2. Evaluation Indicators for Measuring ID and LRCC

2.1. Evaluation Indicators for Measuring ID

ID refers to the process of the generation, growth, and evolution of an industry, including the evolution process of industries [20]. This process includes both quantitative changes in terms of the number of enterprises and output of products or services in the industry, as well as qualitative adjustments and changes of the industrial structure [21–24].

Based on the above connotation discussion, this paper constructs a multi-dimensional evaluation index system for ID. These indicators mainly include four dimensions, namely, industrial scale, industrial structure, industrial efficiency and industrial potential. Industrial scale refers to the output scale or operating scale of a specific industry, which can be represented by gross production value or output volume [25]. Industrial structure refers to the proportion of agriculture, industry, and service industries in a country [22,26]. Industrial efficiency refers to the per capita output at a certain developmental stage. Industrial potential refers to the momentum of industrial development [27], which can also be defined as the extent to which the industry can develop in a long-term effect [28,29]. By referring to indicators presented in previous studies in conducting ID evaluation from these four dimensions, a set of indicators in this study for measuring ID can be confirmed by considering the applicability and data availability, as shown in Table 1.

Table 1. Indicators employed in this study for measuring ID.

Dimension	ID Indicators	Unit
Industrial scale	• ID_1 Gross domestic output value	100 million RMB
	• ID_2 The total number of employees in the primary, secondary and tertiary industries	ten thousand people
Industrial structure	• ID_3 Proportion of tertiary industry output to GDP	%
Industrial efficiency	• ID_4 Per capita GDP of employees in the primary industry	RMB/person
	• ID_5 Per capita GDP of employees in the secondary industry	RMB/person
	• ID_6 Per capita GDP of employees in the tertiary industry	RMB/person
Industrial potential	• ID_7 Added value of primary industry	100 million RMB
	• ID_8 Added value of secondary industry	100 million RMB
	• ID_9 Added value of tertiary industry	100 million RMB

2.2. Evaluation Indicators for Measuring LRCC

LRCC refers to the population scale and economic scale that land resources can accommodate in a certain period. Preliminary research on the LRCC is dated back to Malthus's (1798) research on the principle of population [30]. Since then, the related research has expanded substantially with the study objects extending from arable land to grasslands, forests, water, construction land, and other subjects [31,32]. Accordingly, LRCC has become an important reference index for evaluating the development of the regional population, resources, economy, and ecological environment with the rise of sustainable development theory [33–35].

Research on the index for evaluating LRCC has produced abundant results [36–40]. For example, in evaluating the LRCC in 16 cities in the Yangtze River Delta region of China, Liu (2012) established 12 evaluation indicators about LRCC [41], covering the environment, transportation, water resources, and land resources, etc. Qian et al. (2015) developed 20 indicators for measuring LRCC across the economic, social and ecological aspects [42]. Tang et al. (2021) established a comprehensive evaluation index system of LRCC including five dimensions, namely, urban construction, social economy, ID, and urban ecology [16]. By referring to the indicators adopted in previous research, a set of indicators for evaluating the comprehensive carrying capacity of land are established across economic, social, and environmental dimensions, which can be shown in Table 2.

Table 2. Indicators employed in this study for measuring LRCC.

Dimension	LRCC Indicators	Unit
Economic	• $LRCC_1$ Grain production per unit of arable land	kg/ha
	• $LRCC_2$ Secondary and tertiary industry added value per unit of construction land	10,000 RMB
Social	• $LRCC_3$ Residential land area per capita	km^2/10,000 people
	• $LRCC_4$ Public green area per capita	km^2/10,000 people
Ecological	• $LRCC_5$ Population density	Person/km^2
	• $LRCC_6$ Road area per capita	m^2
	• $LRCC_7$ Afforestation area	Hectares
	• $LRCC_8$ Ratio of air quality days equal to or higher than Grade II	%

3. Evaluation Method for ID and LRCC

3.1. Entropy Weight Methods for Calculating Weight Values between Indicators

The entropy weight method (EWM) is a method for comprehensive evaluation of multiple indicators. In using EWM, entropy value is adopted to judge the degree of dispersion of an indicator over a given period of time and the given study objects. The smaller the information entropy value, the greater the degree of dispersion of the indicator, and the greater the impact of the indicator on the comprehensive evaluation (which is reflected by weighting values).

The calculation procedures of indicator weight are shown in the following formulas. Firstly, the original indicator data will be standardized via the following formula:

$$y_{ikj} = \frac{x_{ikj} - min\left\{x_{ikj}\right\}}{max\left\{x_{ikj}\right\} - min\left\{x_{ikj}\right\}} \quad (1)$$

where x_{ikj} represents the original value of ID or LRCC evaluation indicator j for city k in year i, and y_{ikj} represents the standardized value of the indicator j for city k in a year.

Secondly, the weighting values of individual indicators are calculated by adopting the following formulas:

$$p_{ikj} = \frac{y_{ikj}}{\sum_{i=1}^{m}\sum_{k=1}^{s} y_{ikj}} \quad (2)$$

$$e_j = -\frac{1}{\ln(m \times s)} \sum_{i=1}^{m}\sum_{k=1}^{s} p_{ikj} ln p_{ikj} \left(0 \le e_j \le 1\right) \quad (3)$$

$$w_j = \frac{1 - e_j}{\sum_{j=1}^{n}(1 - e_j)} \tag{4}$$

where e_j demonstrates the entropy value of the indicator j and w_j denotes the weighting value of indicator j.

3.2. Linear Weighted Sum Methods for Calculating Evaluation Results of LRCC and ID

The linear weighted sum method (LWSM) is commonly used for evaluating the performance of a system that consists of multiple dimensions of indicators. By using this method, the evaluation results of LRCC and ID can be obtained by using the following model (5):

$$U_i = \sum_{j=1}^{n} w_j \, y_{ikj} \tag{5}$$

where U_i represents the evaluation result of ID and LRCC, respectively.

3.3. The Model of Matching Degrees between ID and LRCC

The coupling coordination degree model is used to analyze the coordinated development level between two or more systems [42,43]. Coupling coordination degree obtained from applying the model refers to the interactive benign influence between two or more systems, which can reflect the quality of coordination [44] (Ji Zheng et al., 2020).

The coupling coordination degree model is applied in this study to investigate the MD between ID and LRCC. The value of MD between the two systems, namely, ID (U_1) and LRCC (U_2) can be calculated through the following formula:

$$\mathrm{C} = \sqrt{(U_1 \times U_2) / \left(\frac{U_1 + U_2}{2}\right)^2} \tag{6}$$

$$\mathrm{T} = \alpha U_1 + \beta U_2 \tag{7}$$

$$\mathrm{MD} = \sqrt{\mathrm{C} \times \mathrm{T}} \qquad (0 \leq \mathrm{MD} \leq 1) \tag{8}$$

where C represents the coupling degree of ID and LRCC. T represents the comprehensive evaluation index of ID and LRCC. U_1 represents the performance of ID, and U_2 represents the performance of LRCC, both of which are calculated by applying the formula (5). α and β denote the contribution rate of U_1 and U_2, respectively, and in this study, the circumstance of "$\alpha = \beta = 1/2$" is adopted given the fact that ID (U_1) and LRCC (U_2) are equally important. MD will be used to reflect the matching level between ID and LRCC, which can be well matched, barely matched, slightly matched, rarely matched. The criteria for defining the matching level are specified in Table 3.

Table 3. The criteria of MD performance.

MD Performance Zones	Specification Criteria
Well matching zone	$0.8 < \mathrm{MD} \leq 1.0$
Barely matching zone	$0.5 < \mathrm{MD} \leq 0.8$
Slightly matching zone	$0.3 < \mathrm{MD} \leq 0.5$
Rarely matching zone	$0 < \mathrm{MD} \leq 0.3$

4. Research Data

4.1. Case Cities

A total of 16 main cities in Xinjiang were selected as case objects by considering their land resources, industries, and population scales, as shown in Figure 1. According to the data in 2018, 16 case cities have urban areas of 194,996 square kilometers, accounting for 84.24% of Xinjiang's urban area. Additionally, the GDP of the 16 research cities was

746.509 billion RMB, accounting for 61.2% of Xinjiang's total GDP. Data about their land resources, industries, and population scales are also presented in Table 4.

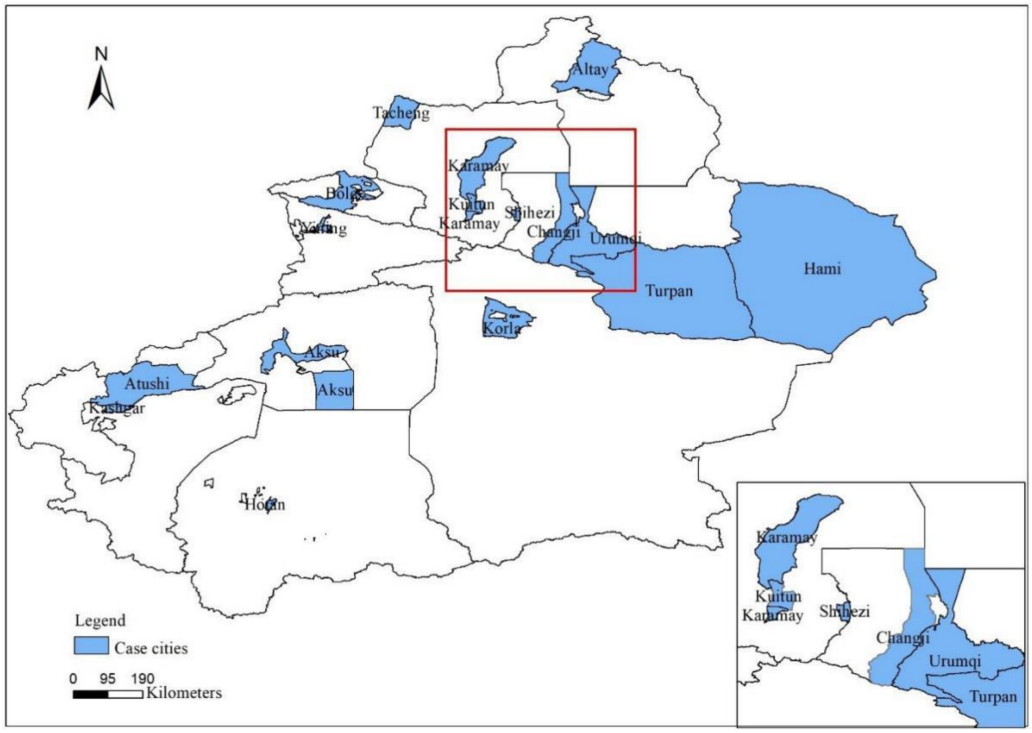


Figure 1. The location of the case cities in this paper.

Table 4. The main industries, land scales, and population scales of the 16 main cities in Xinjiang for the year 2018.

Case Cities	Distance to Urumqi (km)	Main Industries	Land Scale (km^2)	Population Size (10,000 People)
Urumqi	0	Petrochemical, metallurgy, textile, food, medicine machinery, building materials light, electronic	13,787.9	217
Karamay	280	Oil industry	7735.2	30.7
Shihezi	130	Non-ferrous metal processing, chemical manufacturing industry	460	36.1
Turpan	180	Crop farming	15,729.2	29.2
Hami	490	Melons, fruits	85,035	43.2
Changji	35	Tourism, non-ferrous metal processing, chemical manufacturing, non-metallic products, agricultural and sideline food processing	7971	36.3
Yining	70	Planting industry, tourism	644	57.1
Kuytun	24	Agriculture, animal husbandry, grain, oil cotton	1109.9	13.5
Tower	650	Foreign trade	4356.6	16.4
Altay	667	Tourism	10,826	16.4
Bole	448	Industry, commerce, tourism, real estate development	7956	26.8
Korla	600	Transportation, logistics	7267.3	48.7
Aksu	1126	Long-staple cotton, textile, cement, chemical industry	14,400	51.3
Artux	1553	Melons and fruits	16,151	28.6
Kashgar	1588	Foreign trade, export	1056.8	65.2
Hetian	2073	Silk, wool carpet, Hetian jade, Uighur medicine	510.2	40.9
Xinjiang cities	—	—	231,488	885
Percentage (%)	—	—	84.24	85.58

4.2. Data

The sources of original data for all the LRCC and ID evaluation indicators listed in Tables 1 and 2 are shown in Table 5, and the data is collected across a 10-year time period from 2009 to 2018.

Table 5. Data sources for LRCC and ID indicators.

Indicators	Data Sources
$LRCC_1$, $LRCC_2$, $LRCC_4$, $LRCC_8$, ID_1, ID_3, ID_4, ID_5, ID_6, ID_7, ID_8, ID_9	Xinjiang Statistical Yearbook (2010–2019)
$LRCC_2$, $LRCC_5$, $LRCC_6$	China Urban Construction Statistical Yearbook (2010–2019)
$LRCC_7$	China Forestry Statistical Yearbook (2010–2019)
ID_2	Xinjiang Survey Yearbook (2010–2019), Statistical Yearbook of China's Regional Economy (2010–2019)
$LRCC_2$	Statistical Yearbook of Chinese Cities (2010–2019)
ID_4, ID_5, ID_6,	China County Statistical Yearbook (2010–2019)

However, the data for some indicators cannot be obtained directly from the official statistics, such as ID_4 (per capita GDP of employees in the primary industry), ID_5 (per capita GDP of employees in the secondary industry), ID_6 (per capita GDP of employees in the tertiary industry). Therefore, certain data processing calculations are needed:

$$ID_4 = Primary\ industry\ output\ value / Practitioners\ in\ the\ primaryindustry \quad (9)$$

$$ID_5 = Secondary\ industry\ output\ value / Practitioners\ in\ the\ secondaryindustry \quad (10)$$

$$ID_6 = Tertiary\ industry\ output\ value / Practitioners\ in\ the\ tertiaryindustry \quad (11)$$

Furthermore, there is some missing data for some indicators in certain years such as the indicator ID_2 in 2013, and $LRCC_1$ in 2009. All the missing data are complemented by using the linear interpolation method or linear extrapolation method.

Follow the above data processing process, the research data of 16 cities in Xinjiang from 2009 to 2018 were obtained. As the complete database of the 16 cities is too large to be included in the paper, only the data for a sample case city of Urumqi is shown in Table 6.

Table 6. Research data for the case city of Urumqi from 2009 to 2018.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
ID_1	10,727,645	13,027,147	16,215,843	18,954,206	20,584,716	22,646,800	23,873,124	24,589,766	27,306,455	30,997,659
ID_2	132.50	135.30	139.95	142.62	145.44	165.25	174.48	181.22	189.99	194.93
ID_3	55.54	53.00	53.78	57.34	59.08	62.10	67.10	70.20	68.90	68.50
ID_4	13,334.58	14,941.49	18,788.38	20,769.77	24,012.09	24,459.23	27,234.29	30,253.01	27,000.11	27,877.95
ID_5	130,775.83	165,780.87	5762.91	6149.68	6609.28	6872.25	211,501.17	194,122.88	214,642.55	239,958.49
ID_6	69,706.93	79,380.09	90,908.04	110,138.24	116,541.57	112,574.91	124,335.05	127,295.07	132,198.48	145,362.78
ID_7	160,015	186,918	202,163	218,498	226,434	235,787	265,262	281,353	250,021	257,871
ID_8	4,642,542	5,934,955	7,458,323	8,099,657	8,500,177	8,755,677	7,582,317	7,040,837	8,237,981	9,509,555
ID_9	5,925,089	6,905,274	8,555,356	10,636,050	11,858,110	13,655,340	16,025,550	17,267,580	18,818,450	21,230,230
$LRCC_1$	6422	6089	6619	6955	7601	7543	7661	7532	7993	7993
$LRCC_2$	31,151.82	37,471.12	41,724.02	50,856.97	52,040.61	54,361.37	54,907.12	55,753.25	61,764.21	68,560.50
$LRCC_3$	0.41	0.41	0.40	0.50	0.52	0.54	0.56	0.57	0.57	0.58
$LRCC_4$	0.14	0.13	0.15	0.14	0.15	0.16	0.16	0.16	0.18	0.19
$LRCC_5$	8230	8148	7572	8111	7784	7466	2123	2043	1929	1874
$LRCC_6$	6.88	7.18	7.42	7.45	9.57	10.08	10.34	10.71	10.53	11.76
$LRCC_7$	2868	2092	2975	4096	2729	3231	1853	894	1797	3028
$LRCC_8$	71.80	72.90	75.60	80.80	83.30	84.90	65.20	67.20	66.00	74.19

5. Results

5.1. Performance Value for ID and LRCC

By applying the research data specified in the previous section to Equations (1)–(5) in the evaluation method part, the performance values of ID and LRCC of 16 case cities can be obtained, as shown in Tables 7 and 8, respectively.

Table 7. Industry development (ID) performance values of 16 case cities in Xinjiang.

City	ID Performance Value									
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Urumqi	0.3403	0.3839	0.4412	0.4929	0.5247	0.5816	0.6200	0.6413	0.6938	0.7624
Karamay	0.1109	0.1540	0.1714	0.1751	0.1844	0.1920	0.1585	0.1573	0.1786	0.2043
Shihezi	0.0491	0.0569	0.0646	0.0719	0.0839	0.0878	0.0953	0.0939	0.0988	0.1077
Turpan	0.0376	0.0429	0.0443	0.0571	0.0604	0.0606	0.1070	0.1136	0.1214	0.1370
Hami	0.0819	0.0951	0.0685	0.0785	0.0906	0.1013	0.0993	0.1289	0.1422	0.1539
Changji	0.1030	0.1220	0.1328	0.1570	0.1703	0.1927	0.2077	0.2137	0.2169	0.2338
Yining	0.0840	0.0862	0.0545	0.0621	0.0628	0.0690	0.0694	0.0713	0.0754	0.0781
Kuytun	0.0439	0.0468	0.0631	0.0669	0.0606	0.0583	0.0648	0.0624	0.0678	0.0729
Tower	0.0323	0.0344	0.0394	0.0469	0.0484	0.0724	0.0651	0.0582	0.0710	0.0762
Altay	0.0744	0.0890	0.0345	0.0361	0.0396	0.0360	0.0377	0.0381	0.0364	0.0580
Bole	0.0661	0.0725	0.0938	0.0981	0.0516	0.0769	0.1117	0.1358	0.0994	0.1009
Korla	0.1175	0.1354	0.1551	0.1662	0.1788	0.1944	0.1840	0.1633	0.1661	0.1762
Aksu	0.0543	0.0636	0.0698	0.0768	0.0819	0.0874	0.0922	0.0927	0.0997	0.1083
Artux	0.0275	0.0323	0.0312	0.0336	0.0293	0.0501	0.0330	0.0336	0.0346	0.0680
Kashgar	0.0479	0.0523	0.0543	0.0883	0.0838	0.0732	0.0741	0.0706	0.0731	0.0766
Hetian	0.0481	0.0706	0.0835	0.0964	0.1019	0.1194	0.1281	0.1392	0.1495	0.1606

Table 8. Land resource carrying capacity (LRCC) performance values of 16 case cities in Xinjiang.

City	LRCC Performance Value									
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Urumqi	0.2325	0.2196	0.2488	0.3010	0.2747	0.2913	0.2073	0.1850	0.2162	0.2659
Karamay	0.5572	0.4082	0.4229	0.4079	0.3987	0.3828	0.4630	0.3612	0.4074	0.4207
Shihezi	0.1547	0.1607	0.1777	0.2058	0.2107	0.2264	0.2165	0.2122	0.2053	0.1982
Turpan	0.2007	0.2019	0.2115	0.2527	0.2595	0.3048	0.3969	0.4602	0.5340	0.6336
Hami	0.1770	0.1902	0.2094	0.2082	0.2097	0.2160	0.1939	0.2634	0.2912	0.3109
Changji	0.3164	0.2377	0.2342	0.2496	0.2641	0.2787	0.2589	0.2313	0.2158	0.2284
Yining	0.2026	0.1942	0.2269	0.2266	0.2313	0.2312	0.1714	0.1831	0.1990	0.1950
Kuytun	0.1622	0.1476	0.1934	0.1958	0.2068	0.2083	0.1753	0.1510	0.1441	0.1520
Tower	0.1762	0.1723	0.2029	0.2395	0.2252	0.2311	0.1898	0.1808	0.1966	0.2157
Altay	0.2014	0.1541	0.1947	0.2296	0.2355	0.2471	0.2218	0.2017	0.2199	0.2205
Bole	0.2080	0.4030	0.2643	0.2145	0.1869	0.2282	0.1976	0.1867	0.1874	0.1854
Korla	0.2149	0.1414	0.2630	0.2896	0.2736	0.2617	0.2671	0.2311	0.2962	0.3111
Aksu	0.1742	0.1712	0.2201	0.1778	0.1792	0.2043	0.1780	0.1621	0.2255	0.2325
Artux	0.1768	0.1765	0.1534	0.1937	0.1679	0.1752	0.1592	0.1470	0.1895	0.1938
Kashgar	0.1615	0.1314	0.1565	0.1595	0.1597	0.1659	0.1668	0.1543	0.1647	0.1753
Hetian	0.1082	0.1045	0.1178	0.1237	0.1218	0.1091	0.0883	0.0738	0.0766	0.0790

It can be seen from Tables 7 and 8 that the performance for both ID and LRCC has been improving across the study period for the majority sample cities. In exception, Altay and Yining experienced a decline in ID performance, and Karamay, Changji, Yining, Kuytun, Bole, and Hetian experienced a decline in LRCC performance.

5.2. Performance of MD

By applying data in Tables 7 and 8 to Formulas (6)–(8), values of MD between ID and LRCC in reference to the 16 case cities are shown in Table 9.

Table 9. Matching degree (MD) between ID and RECC of 16 case cities in Xinjiang.

City	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Urumqi	0.5303	0.5389	0.5756	0.6206	0.6161	0.6416	0.5987	0.5869	0.6224	0.6710
Karamay	0.4986	0.5007	0.5189	0.5169	0.5207	0.5207	0.5204	0.4882	0.5194	0.5414
Shihezi	0.2952	0.3093	0.3273	0.3488	0.3647	0.3755	0.3790	0.3756	0.3774	0.3823
Turpan	0.2947	0.3050	0.3112	0.3466	0.3538	0.3686	0.4539	0.4782	0.5046	0.5428
Hami	0.3470	0.3667	0.3461	0.3576	0.3713	0.3846	0.3725	0.4292	0.4511	0.4677
Changji	0.4248	0.4127	0.4200	0.4449	0.4605	0.4814	0.4816	0.4715	0.4652	0.4807
Yining	0.3612	0.3597	0.3335	0.3444	0.3472	0.3553	0.3303	0.3380	0.3499	0.3513
Kuytun	0.2905	0.2883	0.3323	0.3384	0.3346	0.3320	0.3265	0.3115	0.3143	0.3245
Tower	0.2747	0.2776	0.2990	0.3255	0.3231	0.3596	0.3334	0.3203	0.3437	0.3580
Altay	0.3499	0.3422	0.2862	0.3016	0.3109	0.3071	0.3024	0.2961	0.2991	0.3362
Bole	0.3425	0.4135	0.3968	0.3809	0.3133	0.3639	0.3855	0.3991	0.3695	0.3699
Korla	0.3987	0.3720	0.4494	0.4684	0.4703	0.4749	0.4709	0.4407	0.4710	0.4839
Aksu	0.3119	0.3231	0.3520	0.3418	0.3481	0.3655	0.3579	0.3501	0.3872	0.3983
Artux	0.2639	0.2747	0.2630	0.2841	0.2648	0.3061	0.2692	0.2651	0.2846	0.3388
Kashgar	0.2966	0.2879	0.3037	0.3445	0.3402	0.3320	0.3334	0.3231	0.3313	0.3405
Hetian	0.2687	0.2931	0.3149	0.3304	0.3338	0.3378	0.3262	0.3183	0.3271	0.3356
Average value	0.3468	0.3541	0.3644	0.3810	0.3796	0.3942	0.3901	0.3870	0.4011	0.4202

The data in Table 9 can also be presented graphically, as shown in Figures 2 and 3. According to the criteria in Table 3, the matching zone can also be defined in Figure 3.

By using the GIS technique, the MD values of 16 cities in Xinjiang in 2009 and 2018 can be presented graphically for further discussion, as shown in Figure 4.

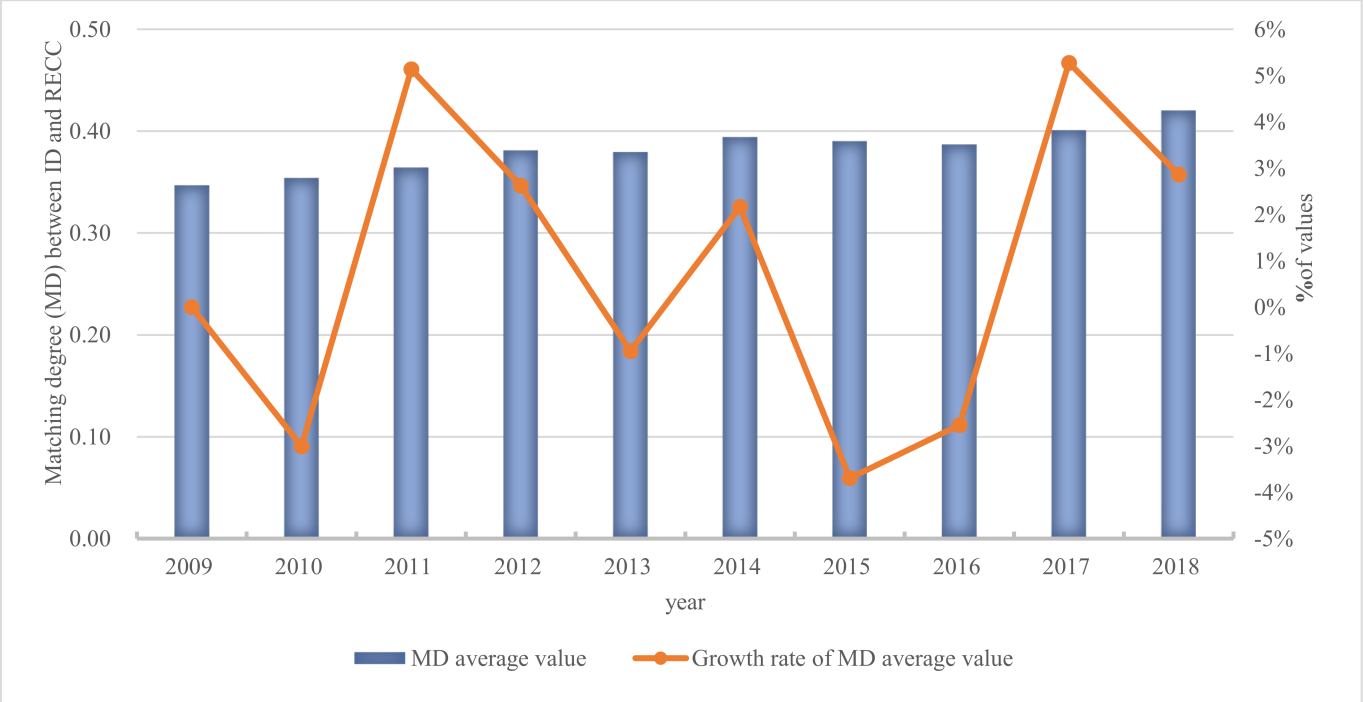


Figure 2. Overall MD performance of 16 cities in Xinjiang across the four performance zones.

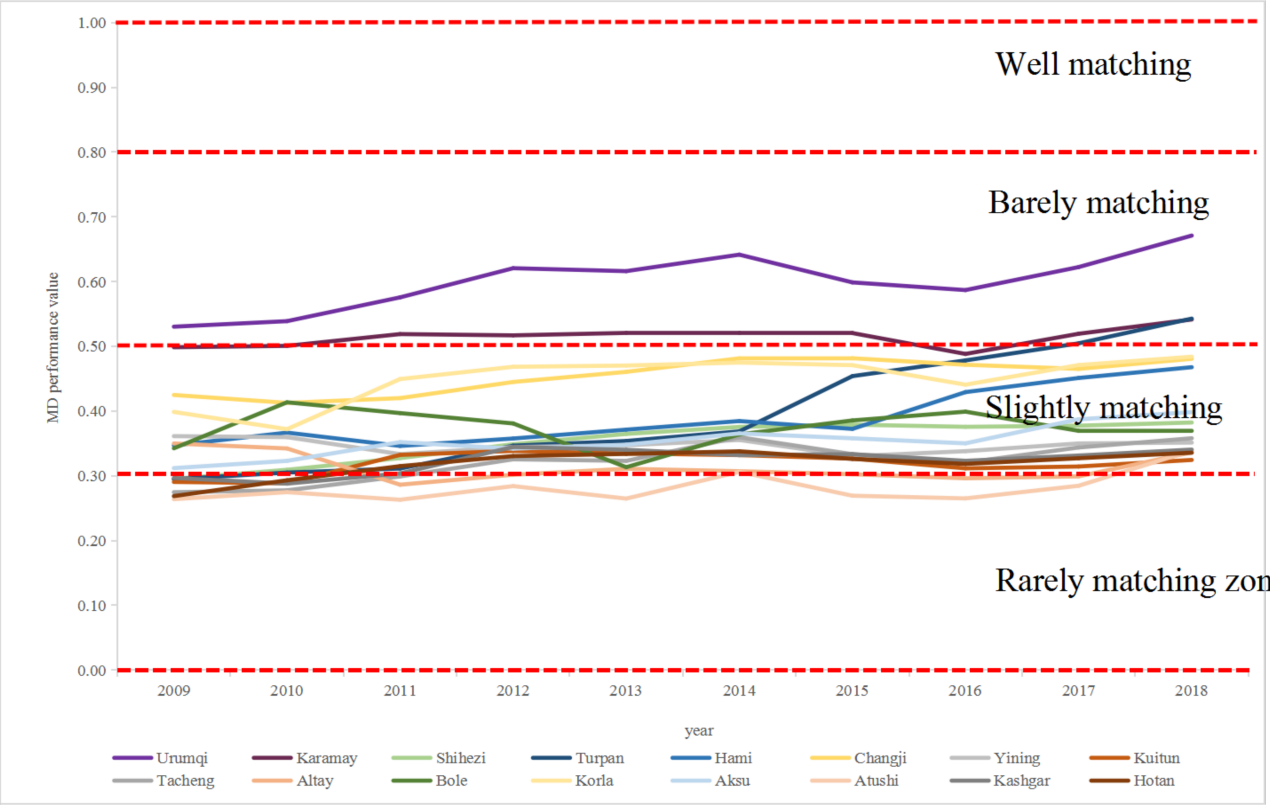
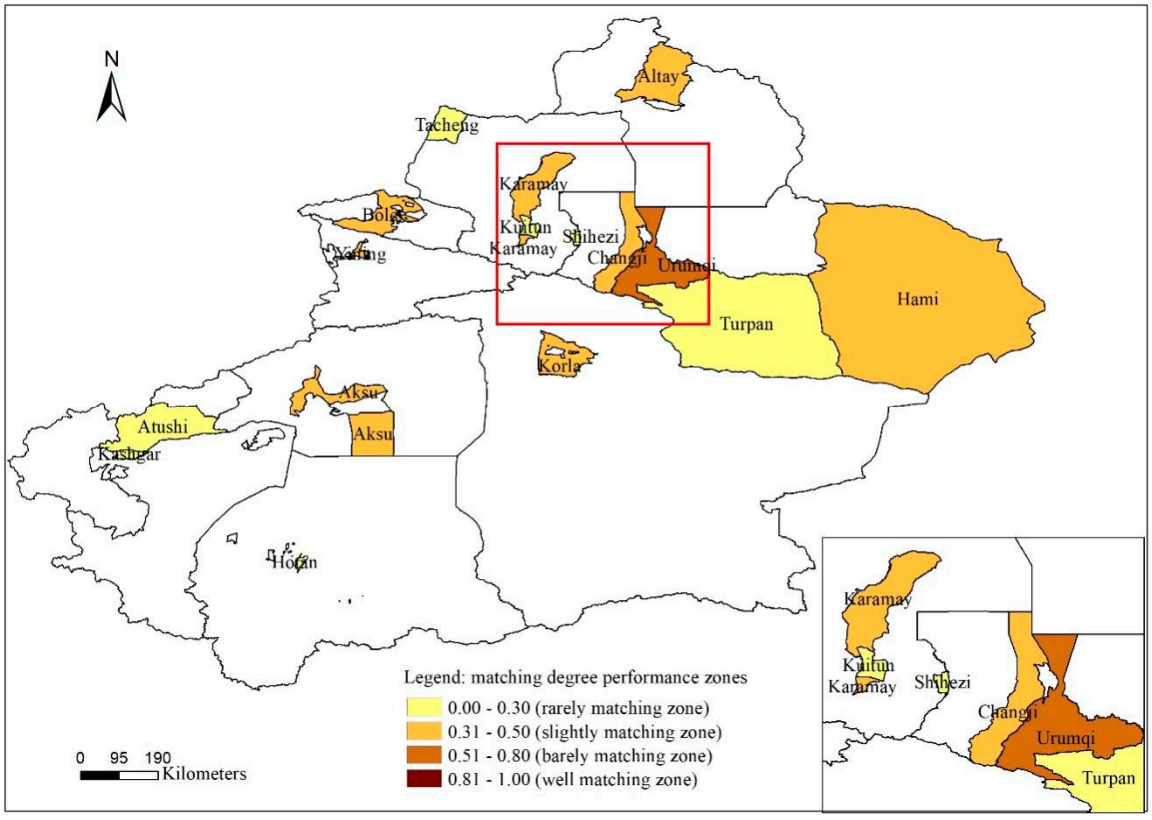
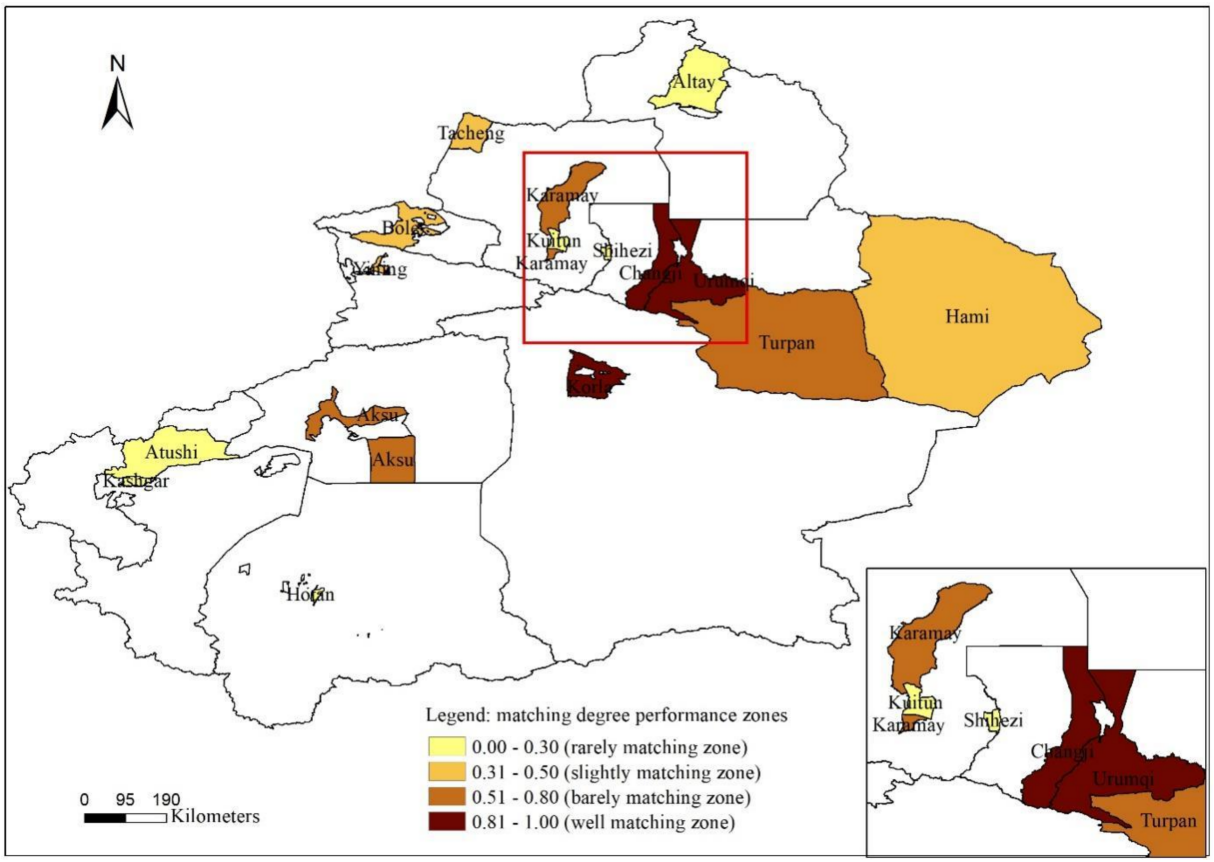


Figure 3. MD performance of the 16 cities in Xinjiang from 2009 to 2018.



(**a**)

Figure 4. *Cont.*



(**b**)

Figure 4. (**a**) The MD values of the 16 cities in Xinjiang for the year of 2009. (**b**) The MD values of the 16 cities in Xinjiang for the year of 2018.

6. Discussion

6.1. The Overall MD Performance of the 16 Cities

According to Figure 2, the average MD of the 16 cities in Xinjiang has experienced steady growth from 0.35 to 0.42 during the 10 surveyed years, indicating that the MD between LRCC and ID in Xinjiang cities has been gradually improving. This is mainly due to the implementation of strategies such as the development of the western region of China. For example, the central government of China had supported 331 ID projects in Xinjiang with a fund of 845 million RMB from 2011 to 2015. The implication of these projects requests for adjusting the traditional industrial structure by incorporating more recycling resource industries. These projects also pointed out to promote tertiary industries such as cultural tourism based on the level of LRCC. On the other hand, the 13th Five-Year Plan of Xinjiang also requires speeding up the construction of a green industrial economy and a land resource-saving society. These strategic measures have helped the ID in Xinjiang cities achieve good results with the decrease of the secondary industry by 10.8% from 2009 to 2018, and the increase of tertiary industry by 22.8%. As a result, the level of ID and LRCC becomes more in harmony with each other. Therefore, the MD level of 16 cities in Xinjiang ID and LRCC was gradually improving from 2009 to 2018.

It can be seen from the above analysis that the Xinjiang government has been playing an important role in improving the matching development of ID and LRCC. However, the data in Fig 3 shows that the level of MD is relatively low, with the max level of 0.42 in 2018, indicating there is still significant room for improvement. Thus, it is considered that the Xinjiang government should enhance the overall development speed and level of the industry, such as strengthening the development of characteristic tourism industries.

Meanwhile, the Xinjiang government can also give priority to the supply of construction land for key industries by scientifically arranging the total quantity, structure, layout, timing, and method of the land.

With reference to the findings in this study, cities in backward regions globally should pay attention to the transformation and upgrading of their traditional industries to improve the matching degree between ID and LRCC. On the other hand, they can develop more green industries such as tourism to protect the local environment. This research finding is also consistent with the research by [45], who pointed out that the development of tourism in a certain area can contribute more to the improvement of LRCC.

6.2. The MD Performance Comparison Analysis between Case Cities

The comparison analysis will be conducted in three aspects. Namely, the overall analysis, good and poor performance analysis, and radiation analysis.

6.2.1. Overall Analysis

As shown in Figure 2, the overall level of MD performances of 16 sample cities in Xinjiang is relatively poor. Only two of the 16 sample cities (Urumqi and Karamay) achieve barely matching MD performance, the others are located in the slightly matching zone, except for the city Atushi that is always in the rarely matching zone. Furthermore, differences in MD performance levels between the 16 cities are very small. The main reason for this is that the central government's policies on LRCC and ID are highly consistent across Xinjiang in promoting industry across all cities, without reflecting differentiation. For example, both city governments of Changji and Korla adopt similar policies to support key industrial enterprises [46]. These policies have similar effects in both cities in promoting the release of land use space within the cities and improving land utilization and industrial output rate per unit area. It can be seen from Figure 3 that the MD values of both Changji and Korla have increased in parallel after the policies were enacted in 2009–2012 [47–49].

Another interesting phenomenon is that all cities have maintained improvement in MD during 2009–2018 although the MD performance level in 16 case cities is still not very satisfactory. The main reason is that the central government has been continuously introducing policies on LRCC and ID, which has driven a continuous increase in the MD performance of Xinjiang cities. For example, the Xinjiang government in recent years has been continuously devoted to promoting the transformation of agricultural operations by incorporating a number of large-scale and characteristic agricultural projects, aiming to improve agricultural land use efficiency. In the period of 2002–2011, Xinjiang invested 1.9 billion RMB to carry out greening and transformation projects in the eastern Xinjiang industrial zone to prevent the destruction of desert sandstorms. These policy measures are effective to ensure normal operation of local enterprises and the healthy development of agriculture and animal husbandry [50]. In 2014, the Xinjiang government emphasized that both the quality and quantity of cultivated land should not be reduced while developing the construction industry [51].

From the findings in this study, it can be found that the support from city governors for key industries plays a very important role in improving ID performances. At the same time, the government's policies for strengthening ecological environment protection and land resources will further enhance the coordination between LRCC and ID. Additionally, this proposition is echoed with the study by [52], who pointed out that industry should be developed based on land carrying capacity. The experience can be extended to other cities globally.

6.2.2. Good and Poor Performance Analysis

As showed in Figure 3, Urumqi city and Karamay city performed the best MD among the 16 cities, locating in the barely matching zone. The MD performance value of Urumqi city is the highest among the 16 cities, rising from 0.53 in 2009 to 0.67 in 2018, and the performance by Karamay rose from 0.5 to 0.54 in the same period. As the capital of

Xinjiang, Urumqi has the largest industrial base and the most reasonable industrial structure due to better policy supports and ID conditions, such as better infrastructure, accessible information exchange mechanism and better supply of high-end talents, etc. Accordingly, the industrial efficiency is relatively high in Urumqi. Furthermore, Urumqi pays great attention to promoting ID by using its LRCC. For example, Urumqi develops the agriculture industry through the control of land desertification. It has established a strict ecological protection system for the development of the construction industry by requesting that "the trees excavated on construction land shall be transplanted to other places equally" [53]. In addition, Urumqi also pays attention to the development of high-tech industries such as the electronics industry to increase the added value of its land resources. Therefore, its ID and LRCC have a better matching degree. On the other hand, as an emerging industrial city, Karamay has achieved a high level of industrialization. Industries in Karamay have a high degree of relevance, thus the agglomeration effect can be gained, especially in processing and commercial industries. At the same time, Karamay has a higher degree of land intensification, which has contributed to the improvement of LRCC level [54]. This is why the MD performance between ID and LRCC is relatively high in the city. The experience of Urumqi can be promoted to other cities globally for improving MD. In line with this, city governments should promote a more reasonable industrial structure based on local conditions, enhance the development of high-tech industries or green industries, and continue to protect the ecological environment. On the other hand, local enterprises and the government should work together to strengthen the management of key industries. Furthermore, the government should provide guarantees and corresponding subsidies for green industries.

It can be further seen from Figure 3 that the MD performance in Turpan City and Hami City have experienced a high level of increase, spanning three zones, from rarely matching zone in 2009 to slightly matching zone in 2009–2017, and rose to the barely matching zone in 2018. This is because Turpan is very good at making use of the locally abundant arable land resources to vigorously develop agriculture and tourism industries, which in turn has promoted the development of both industry and LRCC, thus MD is significantly improved. As for Hami City, it has a relatively high level of tertiary industries such as tourism and business services. Hami City government has also been actively supporting the supply of construction land required for the development of tertiary industrial enterprises, which created a good investment environment for tertiary industries such as tourism and commerce and service industries. Therefore, the level of MD in Hami City has increased gradually.

In contrast, the MD performance in Altay City and Yining City showed a downward trend during the study period. This is mainly because the traditional industry in the two cities used to be agriculture dominated. However, the land for agriculture has been used in recent years for other types of industries such as the ski industry. However, the ski industry in these cities has not developed successfully, instead, a large amount of pastoral land has been eaten, leading to a decrease in LRCC [55].

6.2.3. Radiation Analysis

Figure 4 shows the spatial evolution of MD in the case cities in Xinjiang from 2009 to 2018. It can be seen that the level of MD in northern Xinjiang is better than that in southern Xinjiang. The major reasons for this spatial difference are in two aspects. On one hand, the city Urumqi, as a core city in northern Xinjiang, has a radiation effect in promoting MD performance of other cities in northern Xinjiang. For example, Urumqi has the largest transit hub in Xinjiang, which provides very essential conditions for industrial development between cities around Urumqi. Urumqi also tends to develop industrial cooperation with the surrounding cities, which have also driven the ID and promoted the efficient use of LRCC in other surrounding cities [56]. On the other hand, there is no leading city in southern Xinjiang where the natural environment is very harsh and the economic condition is very weak [57]. Therefore, it suggests that southern Xinjiang should

focus on developing leading cities. In order to develop such a radiation city, a favorable policy environment should be carried out for its industrial development, especially in investment, credit, finance, priority supply of land, and preferential land prices in the city. For example, by developing Aksu city as the core radiation city in the southern Xinjiang region, the MD level in the southern region of Xinjiang can be improved. It can be seen that the development of transportation hub cities in backward areas is essential to help strengthen industrial cooperation with surrounding regions, which can lead to the formation of industrial clusters through the radiation function.

7. Conclusions

This study investigated the matching state between industrial development (ID) and land resource carrying capacity (LRCC) in main cities of Xinjiang in China for the period of 2009–2018. A multi-dimensional evaluation index system is established to measure ID by considering industrial scale, industrial structure, industrial efficiency and industrial potential. On the other hand, a comprehensive evaluation index system is developed to measure LRCC by incorporating economic, social, and environmental elements.

The main research findings can be summarized as follows:

(1) Overall MD performance of the main cities in Xinjiang has been gaining steady growth, although the level of MD values is located in the slightly matching zone in the study period.
(2) The differences in MD performance levels between the 16 sample cities are very small. Even the two best MD performers, namely, Urumqi city and Karamay, are still in the barely matching zone.
(3) The level of MD in the northern cities in Xinjiang is better than that in southern Xinjiang. This is mainly because of the radiation effect of Urumqi in northern cities. It is therefore suggested developing such a radiation city in southern Xinjiang in order to improve MD performance in southern Xinjiang.

By drawing upon the research findings, policy recommendations can be proposed as follows: firstly, it is suggested that backward areas like Xinjiang of China should adopt proper policies to promote the environment-friendly industries as their key industries based on the local conditions. Secondly, it is recommended to strengthen the role of government in these backward areas to support the development of key industries such as tourism and strengthen land resource protection. Thus, coordinated development between ID and LRCC can be promoted. Thirdly, it is recommended to promote the radiation-driven effect of key cities such as Urumqi and Karamay in Xinjiang, through establishing transportation networks between main cities. By this way, an advantageous industrial cluster can be formed, and LRCC can be improved as well. The application of these recommended policies can help improve the matching degree between ID and LRCC at both national and global level.

This study contributes to literature development in studying the relationship between ID and LRCC. Practically, the empirical results can provide policymakers in Xinjiang and other backward cities globally with valuable references in understanding the status of MD between ID and LRCC in the local cities. Thus, tailor-made policy instruments can be formulated to improve the performance of MD for the mission of sustainable development. The research results are also very conducive to ensure the stability of the region by improving the social and economic development level of Xinjiang.

The limitations of this study are appreciated. Although the study examines the MD performance level of sample cities in Xinjiang, there is no in-depth analysis of MD influencing factors. This is a recommendation for studying in future research. Furthermore, more case cities can be incorporated for comparative study.

Author Contributions: Y.L.: Conceptualization, Formal analysis, Investigation, Writing—original draft, Writing—review & editing, Resources; F.S.: Conceptualization, Formal analysis, Investigation, Supervision, Writing—original draft, Writing—review & editing; H.H.: Data curation, Formal analysis, Funding acquisition, Supervision, Writing—review & editing; L.S. (Liyin Shen): Conceptualization, Formal analysis, Funding acquisition, Supervision, Writing—review & editing; W.L.: Data curation, Formal analysis, Writing—review & editing; L.S. (Lingyun Sun): Data curation, Resources. All authors have read and agreed to the published version of the manuscript.

Funding: Fundamental Research Funds for the Central Universities of China (Grant Number: "2021CDJSKZD03" and "2020CDJSK03PT18"); Graduate Research and Innovation Foundation of Chongqing, China (Grant No. "CYB21040").

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Acharya, R.P.; Maraseni, T.; Cockfield, G. Global trend of forest ecosystem services valuation–An analysis of publications. *Ecosyst. Serv.* **2019**, *39*, 100979.
2. Acharya, R.P.; Maraseni, T.N.; Cockfield, G. Local users and other stakeholders' perceptions of the identification and prioritization of ecosystem services in fragile mountains: A case study of Chure Region of Nepal. *Forests* **2019**, *10*, 421.
3. Acharya, R.P.; Maraseni, T.N.; Cockfield, G. An ecosystem services valuation research framework for policy integration in developing countries: A case study from Nepal. *Sustainability* **2020**, *12*, 8250.
4. Kumpula, T.; Pajunen, A.; Kaarlejärvi, E.; Forbes, B.C.; Stammler, F. Land use and land cover change in Arctic Russia: Ecological and social implications of industrial development. *Glob. Environ. Chang.* **2011**, *21*, 550–562.
5. Ministry of Land and Resources of the People's Republic of China. Evaluation of Economical and Intensive Utilization of Urban Construction Land in China. 2017. Available online: https://www.sohu.com/a/251781922_99902814 (accessed on 2 August 2021).
6. Wang, N.; Lee, J.C.K.; Zhang, J.; Chen, H.; Li, H. Evaluation of Urban circular economy development: An empirical research of 40 cities in China. *J. Clean. Prod.* **2018**, *180*, 876–887.
7. Kasimu, A. Analysis of spatial-temporal dynamics pattern of urbanization in xinjiang oasis, using GLCNMO (Global Land Cover by National Mapping Organizations) and DCW (Digital Chart of the World) data. In Proceedings of the 36th IEEE International Geoscience and Remote Sensing Symposium (IGARSS), Beijing, China, 10–15 July 2016; IEEE (Institute of Electrical and Electronics Engineers): Portland, OR, USA, 2016.
8. Millington, R.; Gifford, R. *Energy and How We Live*; Australian UNESCO Seminar; Committee for Man and Biosphere: Paris, France, 1973.
9. Gu, C.; Li, H. A preliminary study on the appropriate scale of regional industries based on the carrying capacity of resources and environment. *Land Nat. Resour. Res.* **2010**, *2*, 8–10. (In Chinese)
10. Guangmin, T. Land resources and economic development for Macao. *Trop. Geogr.* **1999**, *4*, 324–330.
11. Li, D.; Xie, M.; Qiao, F. Extraction of vegetation phenology based on remote sensing technique in Qingyang City, Gansu Province. *Res. Soil Water Conserv.* **2017**, *24*, 136–140.
12. Mendía, J.M.; Roca, J.C.A. The use of territory carrying capacity in an urban development master plan in Neuquén city, Argentina. *Int. J. Environ. Health* **2017**, *8*, 272–281.
13. Niu, F.; Yang, X.; Zhang, X. Application of an evaluation method of resource and environment carrying capacity in the adjustment of industrial structure in Tibet. *J. Geogr. Sci.* **2020**, *30*, 319–332.
14. Cheng, K.; Fu, Q.; Cui, S.; Li, T.X.; Pei, W.; Liu, D.; Meng, J. Evaluation of the land carrying capacity of major grain-producing areas and the identification of risk factors. *Nat. Hazards* **2017**, *86*, 263–280.
15. Gray, M.; Hunter, B.; Howlett, M. *Indigenous Employment: A Story of Continuing Growth*; Australian National University: Canberra, Australia, 2013; pp. 1–12.
16. Tang, Y.; Yuan, Y.; Zhong, Q. Evaluation of Land Comprehensive Carrying Capacity and Spatio-Temporal Analysis of the Harbin-Changchun Urban Agglomeration. *Int. J. Environ. Res. Public Health* **2021**, *18*, 521.
17. Yang, H.; Xi, C.; Zhao, X.; Mao, P.; Wang, Z.; Shi, Y.; He, T.; Li, Z. Measuring the urban land surface temperature variations under Zhengzhou city expansion using Landsat-Like data. *Remote Sens.* **2020**, *12*, 801.
18. Xie, H.; Wang, P.; Huang, H. Ecological risk assessment of land use change in the Poyang Lake eco-economic zone, China. *Int. J. Environ. Res. Public Health* **2013**, *10*, 328–346. [PubMed]

19. Luo, W.; Jiang, Y. An Assessment Model for Land Carrying Capacity from the Social, Economic, and Environmental Sustainability Perspectives. In *International Symposium on Advancement of Construction Management and Real Estate*; Springer: Singapore, 2019; pp. 325–339.
20. Blien, U.; Suedekum, J. Local Economic Structure and Industry Development in Germany, 1993–2001. 2004. Available online: https://ideas.repec.org/p/iab/iabdpa/200501.html (accessed on 7 August 2021).
21. Audretsch, D.B.; Feldman, M.P. R&D spillovers and the geography of innovation and production. *Am. Econ. Rev.* **1996**, *86*, 630–640.
22. Sejkora, J.; Sankot, O. Comparative advantage, economic structure and growth: The case of Senegal. *S. Afr. J. Econ. Manag. Sci.* **2017**, *20*, 1–9.
23. Li, Y. Towards Inclusive and Sustainable Industrial Development. *Development* **2015**, *58*, 446–451. [CrossRef]
24. Samaniego, R.M.; Sun, J.Y. Productivity growth and structural transformation. *Rev. Econ. Dyn.* **2016**, *21*, 266–285. [CrossRef]
25. Macke, J. First Mover Industry Advantage as a Prerequisite for New Industry Development a Comparative Case Study of the Development of the Biopharmaceutical Industry in the USA and the EU. Master's Thesis, University Utrecht, Utrecht, The Netherlands, 2014.
26. Salikhova, O.B.; Krekhivsky, O.V. A New Mechanism for State Support to Technological Innovation for Industrial Development. *Stat. Ukr.* **2018**, *81*, 30–35.
27. Romano, L.; Traù, F. The nature of industrial development and the speed of structural change. *Struct. Chang. Econ. Dyn.* **2017**, *42*, 26–37.
28. London, K.A.; Kenley, R. An industrial organization economic supply chain approach for the construction industry: A review. *Constr. Manag. Econ.* **2001**, *19*, 777–788.
29. Oshima, K. Technological innovation and industrial research in Japan. *Res. Policy* **1984**, *13*, 285–301.
30. Malthus, T.R.; Winch, D.; James, P. *Malthus: An Essay on the Principle of Population*; Cambridge University Press: Cambridge, UK, 1992.
31. Wang, S.H.; Mao, H.Y.; Zhao, M.H. Thinking on the index system design to the land comprehensive carrying capacity–A case study: Coastal region of China. *Hum. Geogr.* **2001**, *4*, 57–61. (In Chinese)
32. De Leeuw, J.; Rizayeva, A.; Namazov, E.; Bayramov, E.; Marshall, M.T.; Etzold, J.; Neudert, R. Application of the MODIS MOD 17 Net Primary Production product in grassland carrying capacity assessment. *Int. J. Appl. Earth Obs. Geoinf.* **2019**, *78*, 66–76. [CrossRef]
33. Abbaszadeh, T.N.; Makhdoum, M.F.; Mahdavi, M. Studying the Impacts of Land Use Changes on Flood Flows by Using Remote Sensing (RS) and Geographical Information System (GIS) Techniques: A Case Study in Dough River Watershed, Northeast of Iran. *Environ. Res.* **2011**, *1*, 1–14.
34. Sun, M.; Wang, J.; He, K. Analysis on the urban land resources carrying capacity during urbanization—A case study of Chinese YRD. *Appl. Geogr.* **2020**, *116*, 102170.
35. Tehrani, N.A.; Makhdoum, M.F. Implementing a spatial model of Urban Carrying Capacity Load Number (UCCLN) to monitor the environmental loads of urban ecosystems. Case study: Tehran metropolis. *Ecol. Indic.* **2013**, *32*, 197–211. [CrossRef]
36. Peng, T.; Deng, H. Comprehensive evaluation on water resource carrying capacity based on DPESBR framework: A case study in Guiyang, southwest China. *J. Clean. Prod.* **2020**, *268*, 1–13. [CrossRef]
37. Tsou, J.; Gao, Y.; Zhang, Y.; Genyun, S.; Ren, J.; Li, Y. Evaluating urban land carrying capacity based on the ecological sensitivity analysis: A case study in Hangzhou, China. *Remote Sens.* **2017**, *9*, 529.
38. Guo, S.; Li, C.; Liu, S.; Zhou, K. Land carrying capacity in rural settlements of three gorges reservoir based on the system dynamic model. *Nat. Resour. Model.* **2018**, *31*, e12152.
39. Wang, Z. Land spatial development based on carrying capacity, land development potential, and efficiency of urban agglomerations in China. *Sustainability* **2018**, *10*, 4701. [CrossRef]
40. Liu, H. Comprehensive carrying capacity of the urban agglomeration in the Yangtze River Delta, China. *Habitat Int.* **2012**, *36*, 462–470.
41. Qian, Y.; Tang, L.; Qiu, Q.; Xu, T.; Liao, J. A comparative analysis on assessment of land carrying capacity with ecological footprint analysis and index system method. *PLoS ONE* **2015**, *10*, e0130315.
42. Yuan, J.; Bian, Z.; Yan, Q.; Pan, Y. Spatio-temporal distributions of the land use efficiency coupling coordination degree in mining cities of western China. *Sustainability* **2019**, *11*, 5288.
43. Chai, J.; Wang, Z.; Zhang, H. Integrated evaluation of coupling coordination for land use change and ecological security: A case study in Wuhan City of Hubei Province, China. *Int. J. Environ. Res. Public Health* **2017**, *14*, 1435.
44. Yuan, H.; Han, L. Golf industry development and land resources utilization. *Pratacult. Sci.* **2006**, *4*, 105–110. (In Chinese)
45. Lundmark, L.; Stjernström, O. Environmental protection: An instrument for regional development? National ambitions versus local realities in the case of tourism. *Scand. J. Hosp. Tour.* **2009**, *9*, 387–405.
46. Changji Prefecture Economic and Information Technology Commission. Compilation of National Industry Policies for Key Industries. 2010. Available online: https://wenku.baidu.com/view/70d16d56ad45b307e87101f69e3143323868f561.html (accessed on 2 August 2021).
47. The China State Technology Lead. China's Sustainable Development. 2009. Available online: http://www.gov.cn/ldhd/2009-11/Council,Let03/content_1455545.htm (accessed on 2 August 2021).

48. The China State Council. Xinjiang Work Symposium. 2010. Available online: http://www.chinadaily.com.cn/dfpd/2010xinjianhy/index.html (accessed on 2 August 2021).
49. National Development and Reform Commission. Several Opinions on Supporting the Healthy Development of Xinjiang's Industries. 2012. Available online: https://www.doc88.com/p-00999962107330.html?r=1 (accessed on 2 August 2021).
50. China State Council. Development Plan for the Economic Belt on the Northern Slope of the Tianshan Mountains. 2011. Available online: http://roll.sohu.com/20121123/n358453502.shtml (accessed on 2 August 2021).
51. Ministry of Land and Resources of the People's Republic of China. Opinions of the Central Committee of the Communist Party of China and the State Council on Promoting Xinjiang's Leap-Forward Development and Long-Term Security. 2010. Available online: https://www.doc88.com/p-7813707261322.html?r=1 (accessed on 2 August 2021).
52. Liu, Y.; Zhou, G.; Liu, D.; Yu, H.; Zhu, L.; Zhang, J. The interaction of population, industry and land in process of urbanization in China: A case study in Jilin Province. *Chin. Geogr. Sci.* **2018**, *28*, 529–542.
53. Urumqi City Government. Notice on the Opinions Issuance on the Implementation of the Greening of Barren Hills in Urumqi. 2011. Available online: http://www.urumqi.gov.cn/gk/zfzn/wzb/158133.htm (accessed on 2 August 2021).
54. Liu, Y.; Hu, W.; Wang, S.; Sun, L. Eco-environmental effects of urban expansion in Xinjiang and the corresponding mechanisms. *Eur. J. Remote Sens.* **2021**, *54* (Suppl. S2), 132–144.
55. An, H.; Xiao, C.; Ding, M. The spatial pattern of ski areas and its driving factors in China: A strategy for healthy development of the ski industry. *Sustainability* **2019**, *11*, 3138.
56. Wang, G.; Yang, D.; Xia, F.; Zhao, Y. Study on industrial integration development of the energy chemical industry in urumqi-changji-shihezi urban agglomeration, Xinjiang, NW China. *Sustainability* **2016**, *8*, 683. [CrossRef]
57. Zhang, J.; Long, W. Binary Structure of City and Countryside in Three Prefectures in Southern Xinjiang. *J. Shihezi Univ. (Philos. Soc. Sci.)* **2014**, *28*, 29–36. (In Chinese) [CrossRef]