

Bio Web City/Region approach to solve ecological issues of "Zwischenstadt"

– Comparison of the Land Use of 2500 km² Zone around Nagoya and Düsseldorf –

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Zusammenfassung

Ise Bay Bioregion befindet sich im Zentrum von Japan und ist ein Land-Marine-Komplex mit konkaven Formen rund um Ise und Mikawa Bay. Die Region umfasst gut entwickelte Industriebereiche sowie produktive Landwirtschaft, Fischerei und forstwirtschaftliche Flächen. Die Gesamtzahl der Landnutzung setzt sich aus 65% Wald, 11% Reisfeld und 4% andere landwirtschaftliche Bereiche sowie 13% Gebäude und Straßen zusammen. Im Stadtplanungsbereich, der vom Ministerium für Land,

Infrastruktur, Verkehr und Tourismus definiert wird, überlappen sich städtische und landwirtschaftliche Nutzungen und weisen eine typische Form der "Zwischenstadt" auf, wie SIEVERTS sie 2003 beschrieben hat. Die Landnutzung in der Ise Bay Bioregion scheint jedoch eine andere Funktion als jene in Deutschland zu haben. In diesem Beitrag werden daher Landnutzungen von Städten rund um Nagoya in der Ise Bay Bioregion mit Städten um Düsseldorf verglichen.

Abstract

Ise Bay Bioregion is located in the center of Japan and defined as the land-marine complex with concave form around the Ise and Mikawa Bay. It includes well developed industry areas as well as productive agricultural, fishery and forestry areas. The total land use consists of 65% forest, 11% paddy field, 4% other agricultural field, and 13% urban land use as building and road. In City Planning Area defined by Ministry of Land, Infrastructure, Transport and Tourism, urban and agricultural land uses are overlapped under insufficient control and have a typical form of "Zwischenstadt" defined by T. SIEVERTS in 2003. But the land use in Ise Bay Bioregion seems to have a different feature of that of Germany. In this paper I will compare the land use of cities around Nagoya in Ise Bay Bioregion with that of cities around Düsseldorf. The fragmentations of forest and intermediate land uses cities around Nagoya are higher than those of cities around Düsseldorf. The biggest issue to create harmonized mixed land use around Nagoya is to improve the collectivity of forest and intermediate land uses.

1. Preface

Ise Bay Bioregion is located in the center of Japan and defined as the land-marine complex with concave form around the Ise and Mikawa Bay (Figure 1). It includes well developed industry areas as well as productive agricultural, fishery and forestry areas with a population of about 11 million people. The total land use consists of 65% forest, 11% paddy field, 4% other agricultural field, and 13% urban land use as building and road in 2006. In Fig. 2A, 2B and 2C the comparison of land use ratio in City Planning Area defined by Ministry of Land, Infrastructure, Transport and Tourism observed by the two different data sources is shown. Comparing to 100m Mesh Date by Digital National Land Information, the land use ratio by Aster/Terra extract by N. USUI is biased to the urban and forest land use. The shift to the urban land use can be explained by the facts that green houses are calculated as urban land uses and some bare grounds are miscounted as urban land uses. The shift to the forest land use can be explained by the facts that in the agricultural land use orchards are included and some agricultural sites are under cultivation abandonment.

In the City Planning Area, urban and agricultural land uses are overlapped under insufficient control and have a typical form of "Zwischenstadt" defined by SIEVERTS in 2003. It is impossible to convert these wide developed areas into few clearly detached compact cities. And it seems to be a clever way to create urban and suburban areas harmonized with nature by developing the concept of "Zwischenstadt." In our institute we named this harmonized land use approach as Bio Web City/Region Approach. It is a city/region, in which nature structures are weaved into continuous urban and suburban areas and efficient ecosystem networks are created. How can we find resources for creating bio webs in existing urban and suburban structure?

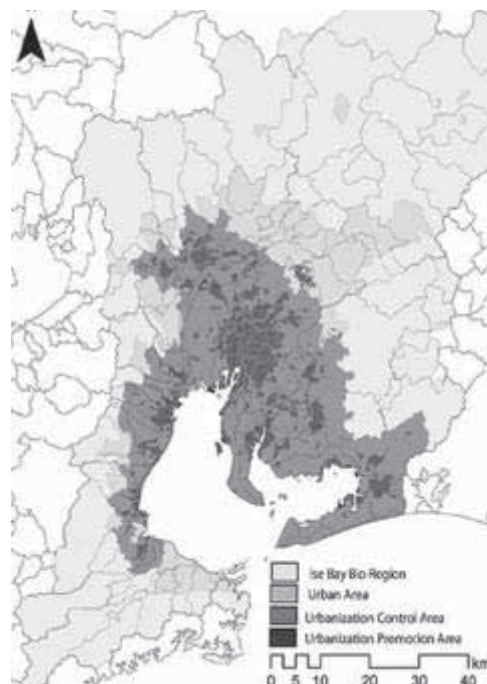


Fig. 1: Planning Areas defined by Ministry of Land, Infrastructure, Transport and Tourism

2. Objectives of Research

In this paper I will show the mixed land use situation in Ise Bay Bio-region using DI (Distribution Index) Scale, and compare it to that around Düsseldorf. From this comparison, I will find out some issues for creating harmonized Bio Web Cities/Regions in future. The focus is on three areas around Nagoya. One is Tsushima City in the South-West Nagoya, in which urban and agricultural small patches are scattered in former wetlands, the second is Konan City in the North-West Nagoya, in which newly developed industries and housing are scattered in agricultural lands, and the third is Nisshin City in East Nagoya, in which newly developed housing areas are scattered in agricultural valleys and forest hills. For the comparison I will examine the land use around Düsseldorf. The satellite images of TERRA/ASTER is used as the data for analysis (Tab. 1, Fig. 2).¹⁾

100m Mesh Land Use Data 2006 by Digital National Land Information			
	Urban	Intermediate	Forest
Urban Area	0.31	0.39	0.30
Urbanization Control Area	0.18	0.52	0.30
Farmland Area	0.10	0.86	0.04
Urbanization Promotion Area	0.79	0.18	0.03
Not Urban Area	0.02	0.08	0.90
Aster/Terra Land Use Extract 2005-6 by N. Usui			
Urban Area	0.32	0.35	0.33
Urbanization Control Area	0.22	0.46	0.32
Farmland Area	0.23	0.67	0.11
Urbanization Promotion Area	0.76	0.21	0.03
Not Urban Area	0.02	0.09	0.89

Tab. 1: Comparison of Land Use Ratio observed by the two different data sources

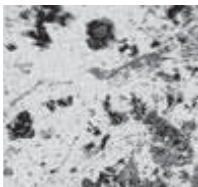


Fig. 2a: Digital National Land Information

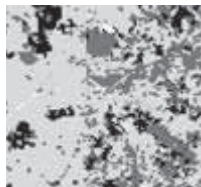


Fig. 2b: Aster/Terra Land Use Extract 2005-6

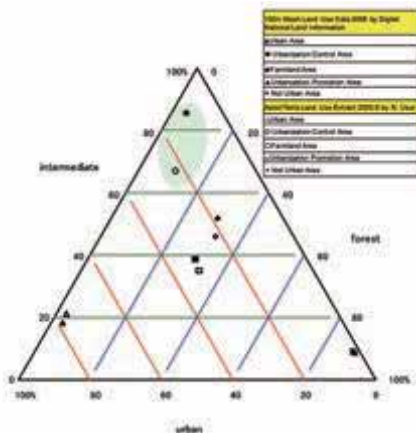
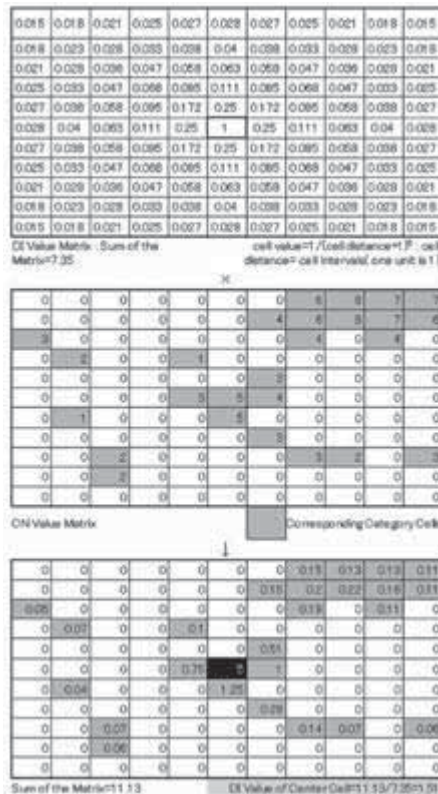


Fig. 2c: Comparison of Land Use Ratio observed by the two different data sources

3. DI value and DI Scale (Rank)

For the observation of collectivity of a targeted land use in a mixed land use, DI Value and DI Scale are developed (MOCHIZUKI et al. 2007).²⁾ The calculation process is shown in Table 2. DI Value for a cell is a continuous number from 0 to 9 according the collectivity of the same land uses in neighborhoods. (0 is a value for a non-correspondence cell.) DI Scale is a Scale with 10 Ranks. The characteristics of DI Value and DI Scale are shown in Table 3. A cell with DI Rank 1,2 or 3 is defined as a Fragment Cell, a cell with DI Rank 4,5 or 6 as a Fringe and Arm Cell, a cell with DI Rank 7,8 or 9 as a Core Cell (Table 3 and Figure 3). Average DI Rank is an average value of all correspondence cells in an observed area. The characteristics of collectivity of a land use can be shown by using Average DI Rank and Covering Rate of a targeted land use (Figure 4). If the Average DI Rank leaves upward from the diagonal line, the land use has a tendency of high collectivity.



Tab. 2: Calculation of DI Values from CN Values



Fig. 3: Patterns of DI Rank

¹⁾ In this paper the two different extracts from TERRA/ASTER are used. The extracts from TERRA/ASTER by N. USUI covers widely in ISE Bay Bioregion, but has the characteristics in which the urban land use is overestimated than that of the 100m Mesh Data by Digital National Land Information. The extract by F. MOCHIZUKI is narrow but can distinguish paddy field and other farmland. The extracted cell size around Düsseldorf is 18.8 by 18.8m, and the cell size around Nagoya is 17.6 by 17.6m.

²⁾ In this paper DI Rank is revalued.

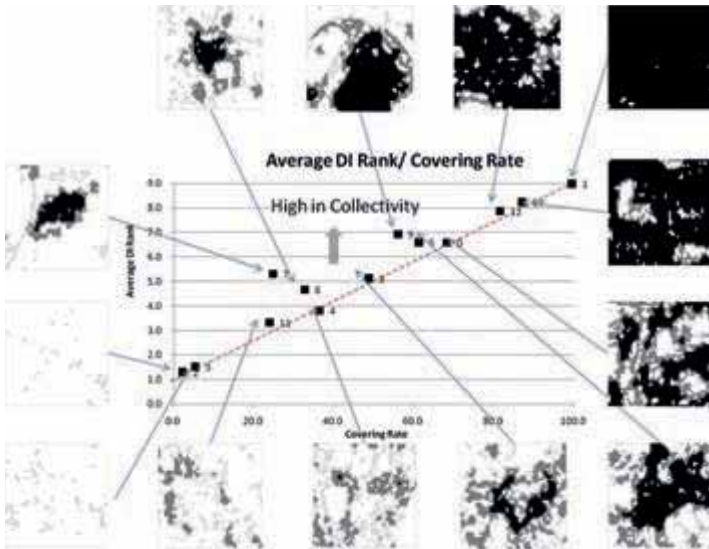


Fig. 4: Average DI Rank and Covering Rate

DI Value	DI Rank	Characteristics	
0	0	Non Correspondence cell	not corresponding
0.00-0.99	1	Scattered cell or thin linear connected cell	scattered and thin collected cells (Fragment Cell)
1.00-1.99	2	Scattered cell or a part of a fringe cell of a collected cells	
2.00-2.99	3		
3.00-3.99	4	a fringe cell of complicated shaped collected cells	low densely connected cells or fringe cells of densely collected cells (Fringe and Arm Cell)
4.00-4.99	5	center cell of small collected cells or a fringe cell of densely collected cells	
5.00-5.99	6	adjacent inner cell of DI Rank 5 cells	inner cells of collected cells (Core Cell)
6.00-6.99	7	adjacent inner cell of DI Rank 6 cells	
7.00-7.99	8	Inner cell of densely collected cells	
8.00-9.00	9		

Tab. 3: Characteristics of DI Values and Ranks

4. Comparison of Land Use around Nagoya and Düsseldorf

From TERRA/ASTER remote sensing data around Nagoya and Düsseldorf, the 2500 km² zones are picked out. Comparing with the land use of Düsseldorf, the rate of forest land use around Nagoya is low, the urban land use is high and the intermediate land use including mostly farmland is low (Figure 5). By the comparison of DI Ranks collectivity of the urban and forest land use around Nagoya and the intermediate land use around Düsseldorf is high, and the urban land use in Düsseldorf and the intermediate land use around Nagoya is medium. Generally speaking collectivities of all land uses around Düsseldorf and Nagoya are both relatively high. But by paying attention to the forest land use, the rate of it around Nagoya is low, but the collectivity of it is very high. It depends on the fact that the forest around Nagoya locate mostly on the north-east mountain side.

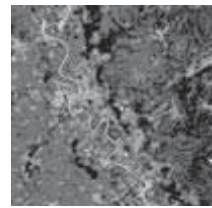


Figure 5a: Düsseldorf 50km x 50km

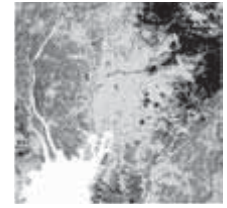


Figure 5b: Nagoya 50km x 50km

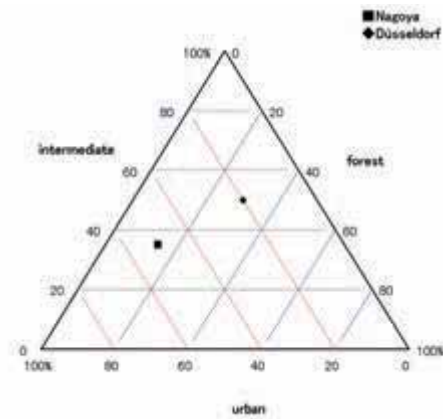


Figure 5c: Land Use in Nagoya and Düsseldorf

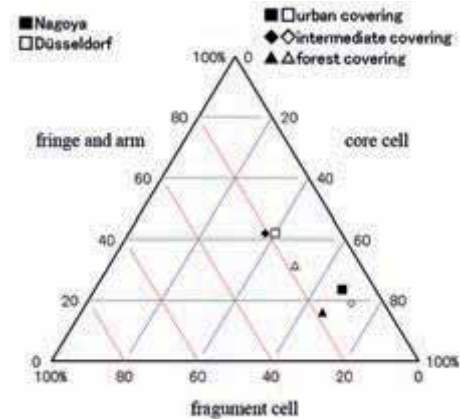


Figure 5d: DI Rank Distribution in 3 Scales of Nagoya and Düsseldorf

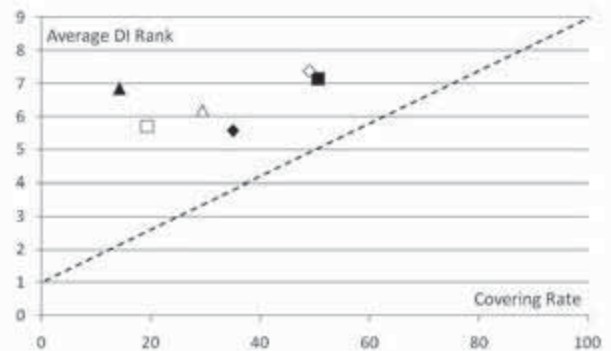


Figure 5e: Average DI Rank and Covering Rate of Nagoya and Düsseldorf

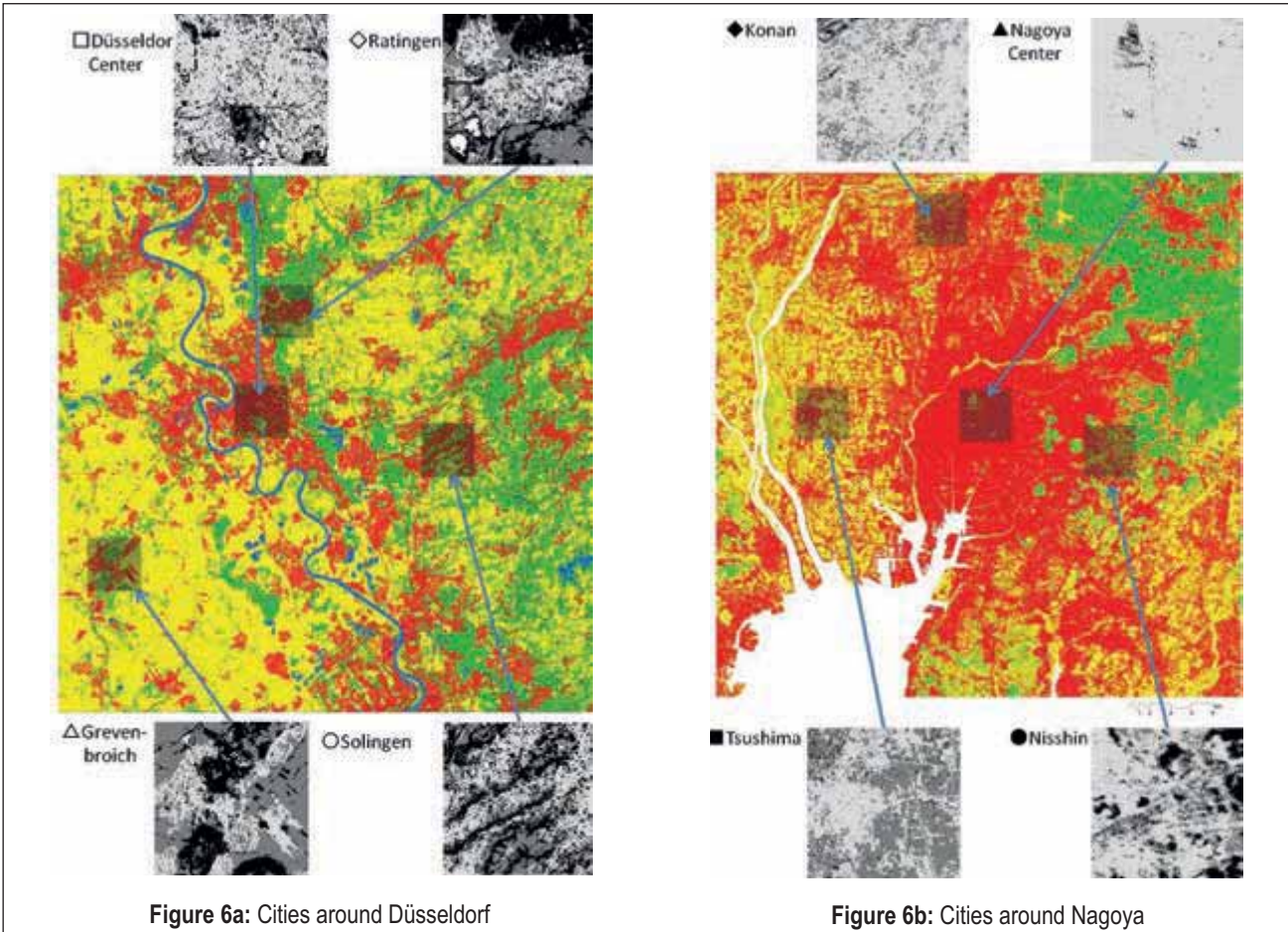


Figure 6a: Cities around Düsseldorf

Figure 6b: Cities around Nagoya

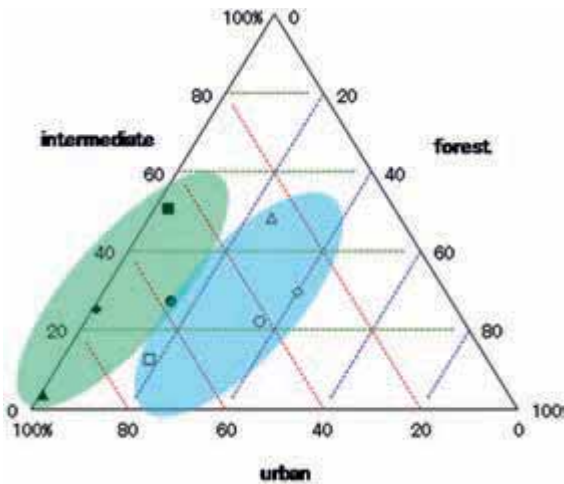


Figure 6c: Comparison of Land Use Rate between Cities around Düsseldorf and Nagoya

The typical characteristic of the cities around Nagoya is the lowness of the forest land use (Figure 6C) comparing to it of cities around Düsseldorf. By the comparison of Average DI Rank and Covering Rate, the forest and intermediate land uses of Tsushima and Konan Cities are specially fragmented, while those of the cities around Düsseldorf are well mixed with the urban land use maintaining relatively high collectivity (Figure 7A, 7B, table 4A, 4B, Figure 8A, 8B). The mixed style of land use of Nisshin is relatively near to that of German cities.

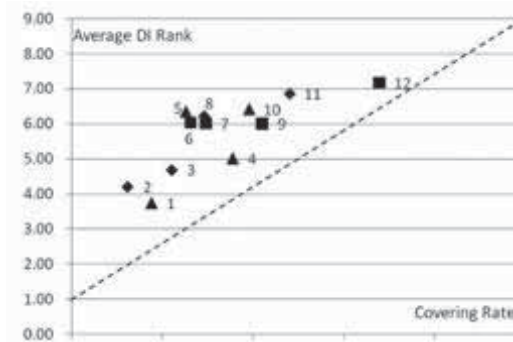


Figure 7a: Average DI Rank and Covering Rate of Cities around Düsseldorf

		DI area rate	DI Rank	Code
■ Urban	Düsseldorf	67.90	7.17	12
	Ratingen	29.61	6.02	7
	Grevenbroich	26.29	6.04	6
	Solingen	42.08	6.00	9
◆ Inter- mediate	Düsseldorf	12.41	4.21	2
	Ratingen	29.27	6.22	8
	Grevenbroich	48.12	6.86	11
	Solingen	22.14	4.69	3
▲ Forest	Düsseldorf	17.72	3.73	1
	Ratingen	39.22	6.41	10
	Grevenbroich	25.29	6.35	5
	Solingen	35.65	5.01	4

Tab. 4a: Land Use Codes of Cities around Düsseldorf

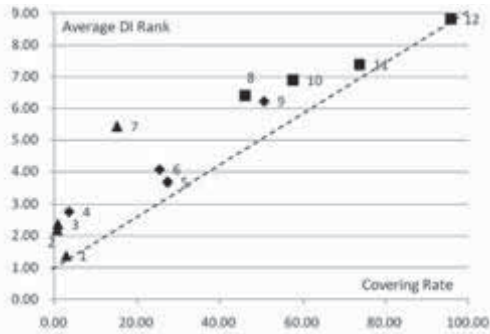


Figure 7b: Average DI Rank and Covering Rate of Cities around Nagoya

		DI area rate	DI Rank	Code
■ Urban	Tsushima	46.02	6.41	8
	Konan	73.70	7.38	11
	Nagoya center	95.75	8.82	12
	Nisshin	57.63	6.89	10
◆ Inter-mediate	Tsushima	50.62	6.22	9
	Konan	25.40	4.07	6
	Nagoya center	3.54	2.76	4
	Nisshin	27.32	3.69	5
▲ Forest	Tsushima	2.79	1.38	1
	Konan	0.85	2.36	3
	Nagoya center	0.71	2.19	2
	Nisshin	15.12	5.43	7

Tab. 4b: Land Use Codes of Cities around Nagoya

a:Düsseldorf

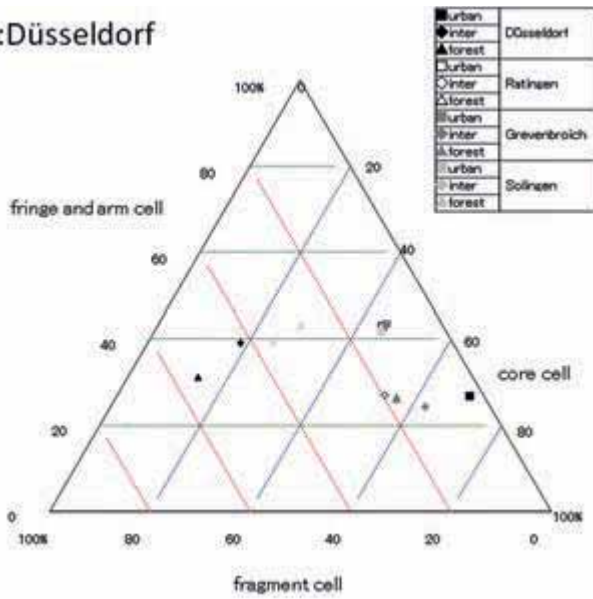


Fig. 8a: Average DI Rank of Cities around Düsseldorf

b:Nagoya

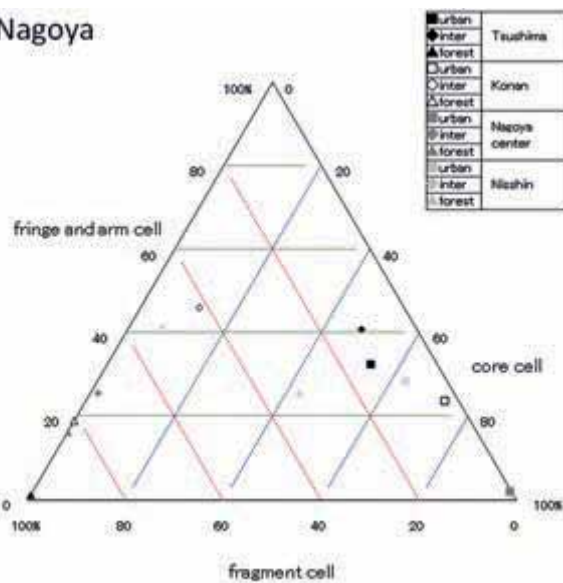


Fig. 8b: Average DI Rank of Cities around Nagoya

5. Conclusion

By using DI Scale and Covering Rate the characteristics of mixed land use situation in different cities/regions can be observed clearly. The situation of the mixed land use, "Zwischenstadt," of 2500 km² around Düsseldorf and Nagoya is very different. The fragmentations of the forest and intermediate land uses of the cities around Nagoya are very high. The biggest issue to create harmonized mixed land use around Nagoya is to improve the collectivity of forest and intermediate land uses in the urban and suburban areas.

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 MOCHIZUKI, F.; SHIMIZU, H.; ARIGA, T. & MINAMI, J. (2007): Grasping method of the pattern and level of the agglomeration of land use using remote-sensing data. Journal of Architecture and Planning 617: 47-54.

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Laufener Spezialbeiträge 2012

Implementation of Landscape Ecological Knowledge in European Urban Practice

ISSN 1863-6446 – ISBN 978-3-931175-96-2

Verkaufspreis 10,- €

Herausgeber und Verlag:

Bayerische Akademie für Naturschutz und Landschaftspflege
Seethalerstraße 6, 83410 Laufen (ANL)

Internet: www.anl.bayern.de

E-Mail: poststelle@anl.bayern.de

Satz: Hans Bleicher, Grafik · Layout · Bildbearbeitung

Druck: Korona Offset-Druck GmbH & Co.KG, Freilassing

Stand: Januar 2012

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Gedruckt auf Papier aus 100 % Altpapier

Schriftleitung:

Ursula Schuster, ANL

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Fax: 08682/8963-16

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Zeitschrift/Journal: [Laufener Spezialbeiträge und Laufener Seminarbeiträge \(LSB\)](#)

Jahr/Year: 2012

Band/Volume: [2012](#)

Autor(en)/Author(s): Shimizu H.

Artikel/Article: [Bio Web City/Region approach to solve ecological issues of "Zwischenstadt" 47-51](#)