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Restructuring existing rural resorts as a sustainable infrastructure for basin socio-ecological systems in Japan: A case of redundant golf courses in the Tokyo Metropolitan Area

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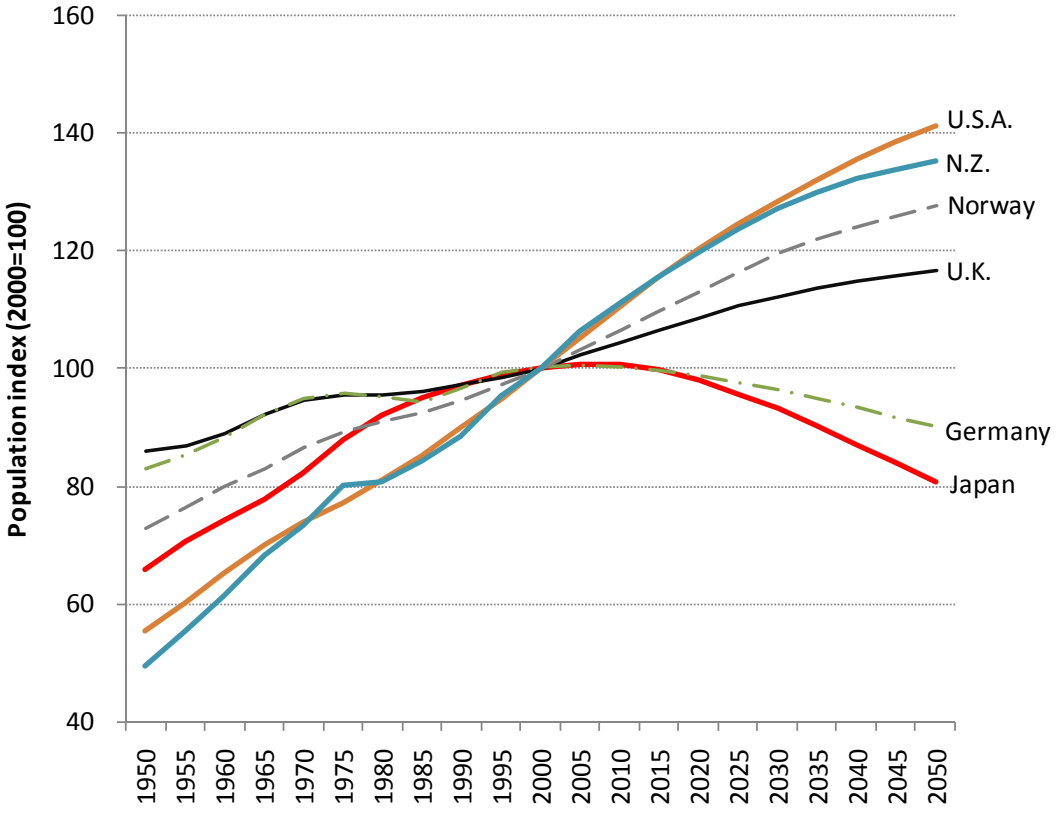
1. INTRODUCTION

- Commercial resort infrastructures have been developed extensively in many rural areas of Japan⇒ >2,400 golf courses & 700 skiing sites
- Following the burst of the bubble economy in the 1990s, several existing resorts faced tough management decisions and some were forced to close their businesses.
- With the trend towards diversification of leisure activities and depopulation, a significant number of resorts are expected to face redundancy or abandonment in the near future.



(Source) UN, World Population Prospects: The 2006

Objective

This study aims to

(1) estimate the number of rural golf courses that will face redundancy or abandonment by 2035 in Japan and the Tokyo Metropolitan Area (Tokyo MA),

(2) identify which golf courses will be potentially redundant in the Tokyo MA and

(3) propose alternative management options for restructuring the existing golf courses into a sustainable infrastructure for basin socio-ecological systems.

2. MATERIALS AND METHODS

(1) Estimation Model of Future Demand for Golf Courses

The number of necessary golf courses $(GC) = (P \times Rt \times F)/CP$

***P*: the potential population of golf players (age 20-64)**

×

***Rt*: the participation rate (%) of playing golf in the target population**

(P) × (2 cases)

***F*: the annual frequency of playing golf per player (times player^{-1} year^{-1})**

÷

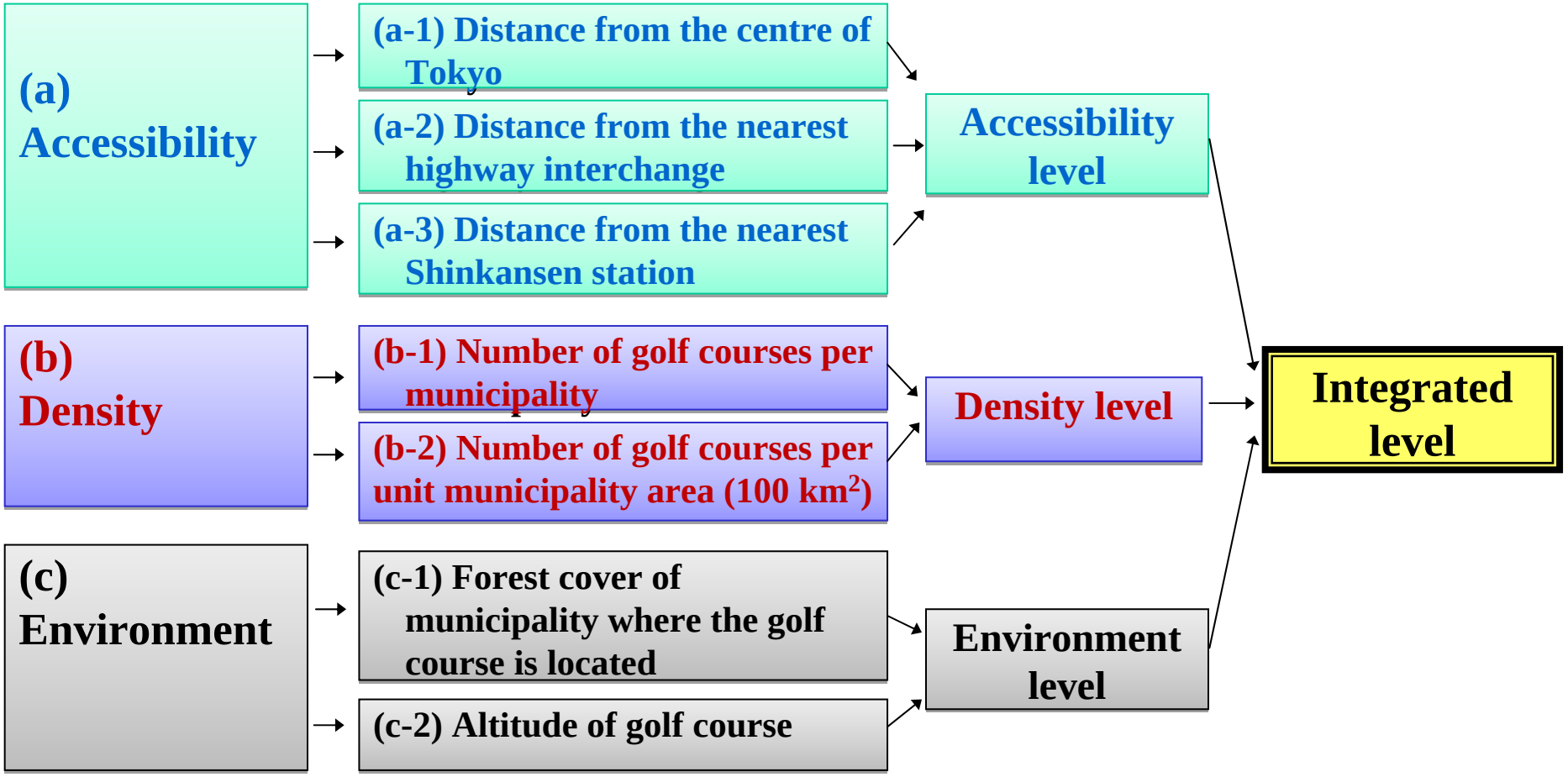
***CP*: the annual cumulative number of players per golf course**

48,392 players per course in the Tokyo MA and
45,155 players per course in the rest of Japan

* Monte Carlo simulation by providing a logistic distribution (mean: 11.6, scale: 0.6) for *F*.

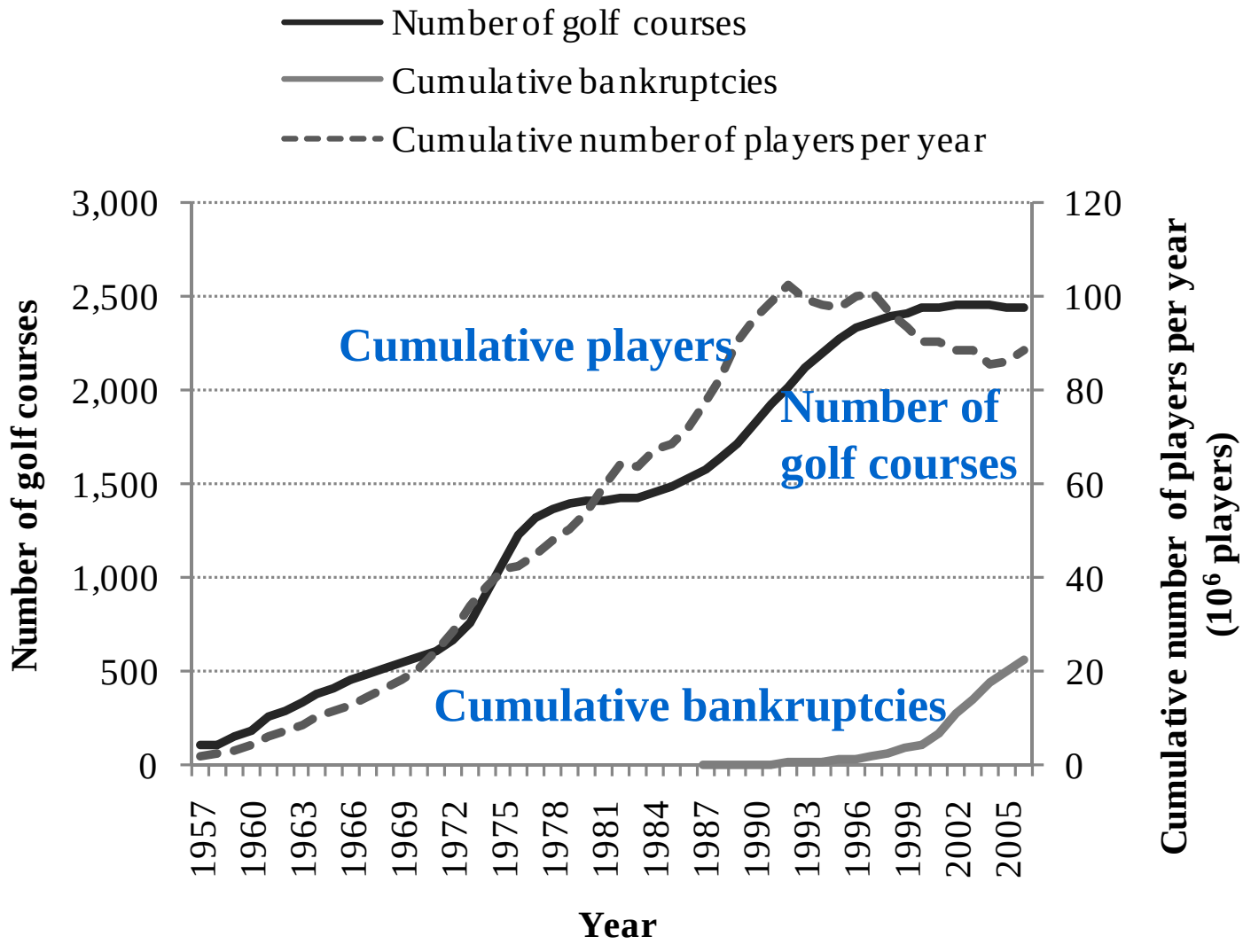
Redundant golf courses $(RC) = Existing\ courses - GC$

(2) Spatial Distribution Analysis Model of Redundant Golf Courses

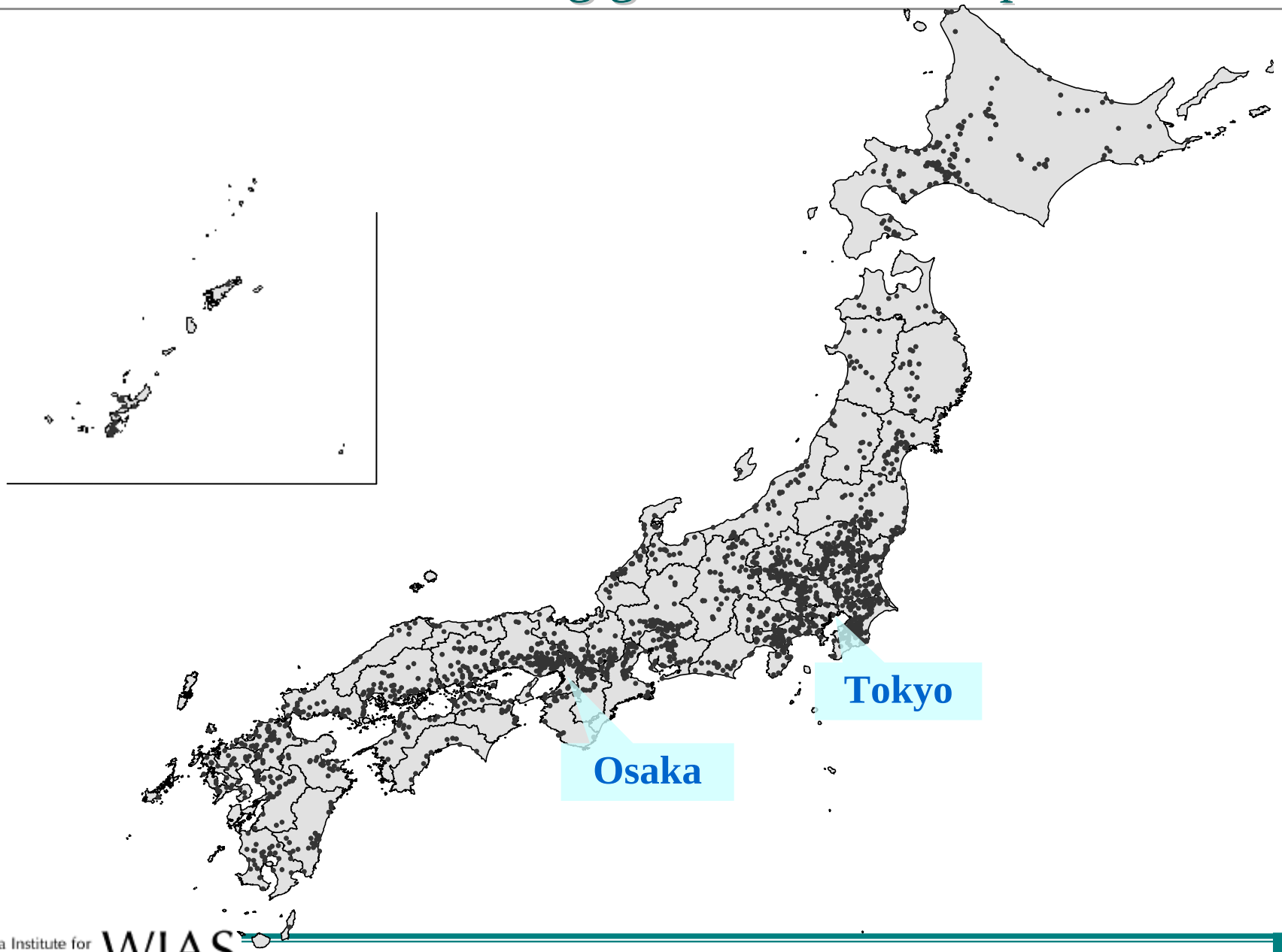


3. RESULTS & DISCUSSION

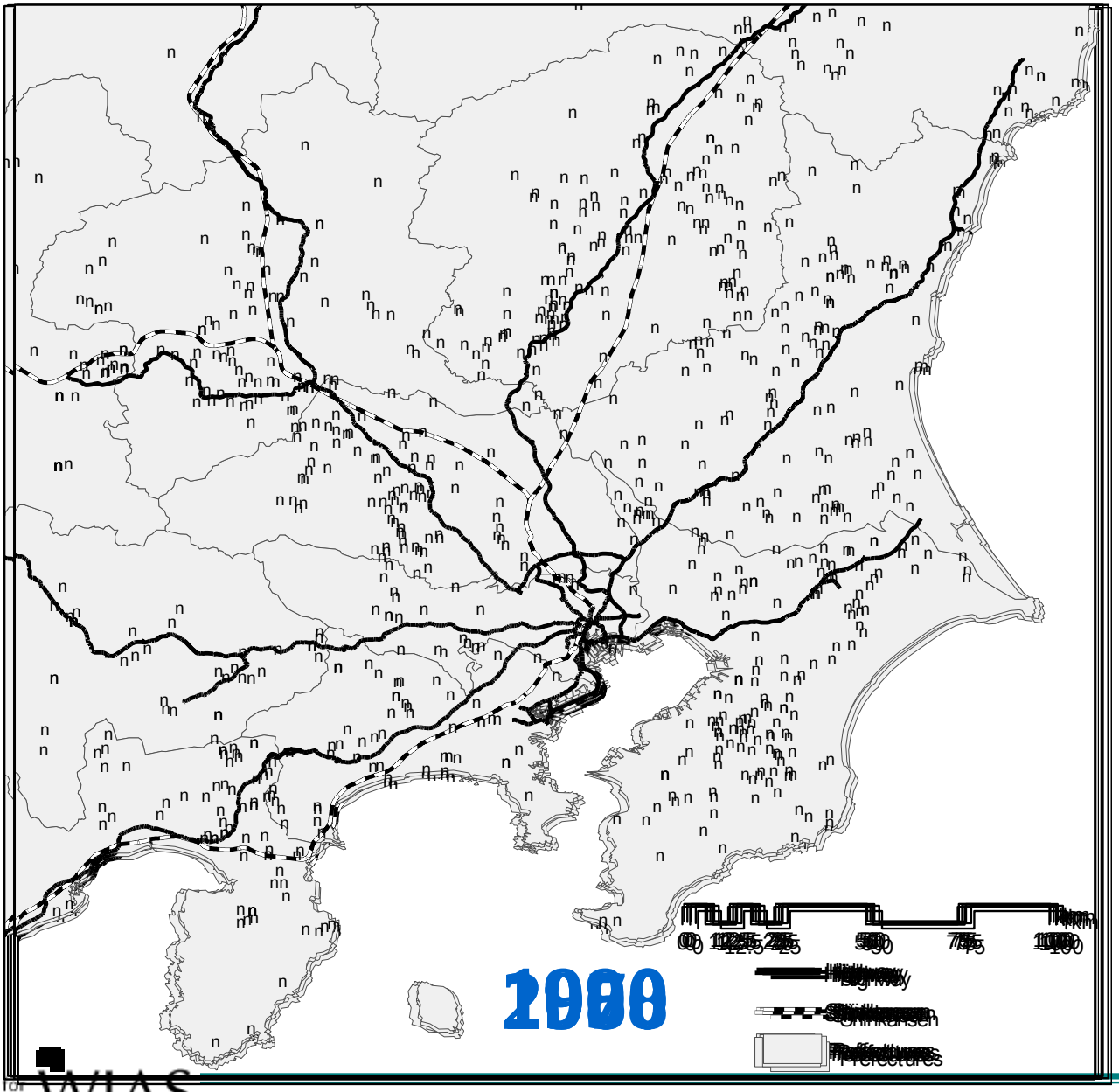
3.1 Development History of Golf Courses in Japan



Distribution of the existing golf courses in Japan



Expansion of golf course construction in the Tokyo MA



2008: Over 800 courses in Tokyo MA

3.2. Redundant Golf Courses by 2035

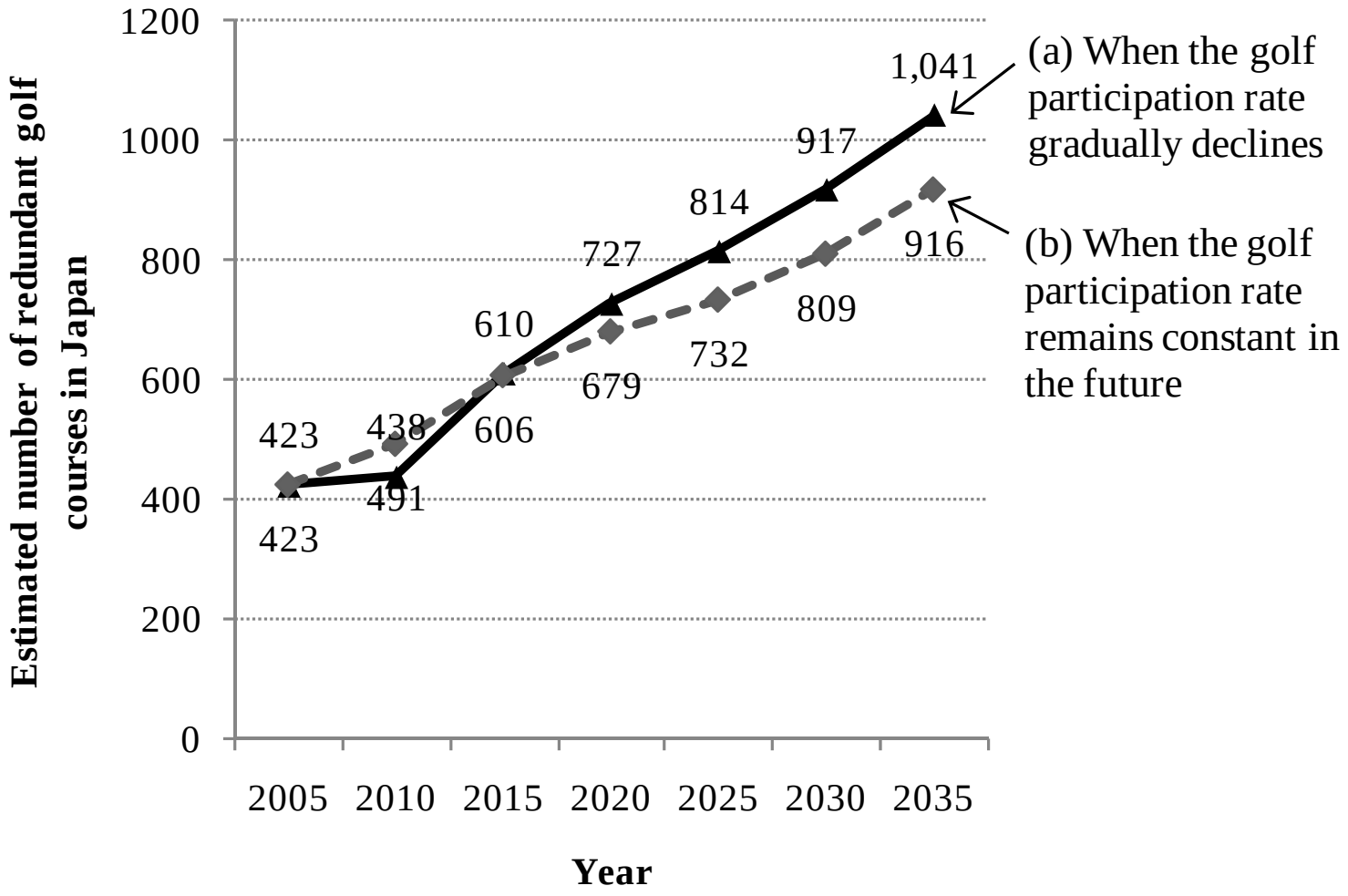


Figure 4 Estimation results of redundant golf courses in Japan

Table 1 Estimated results of the number of redundant golf courses in the Tokyo MA and Japan when the golf participation rate gradually declines

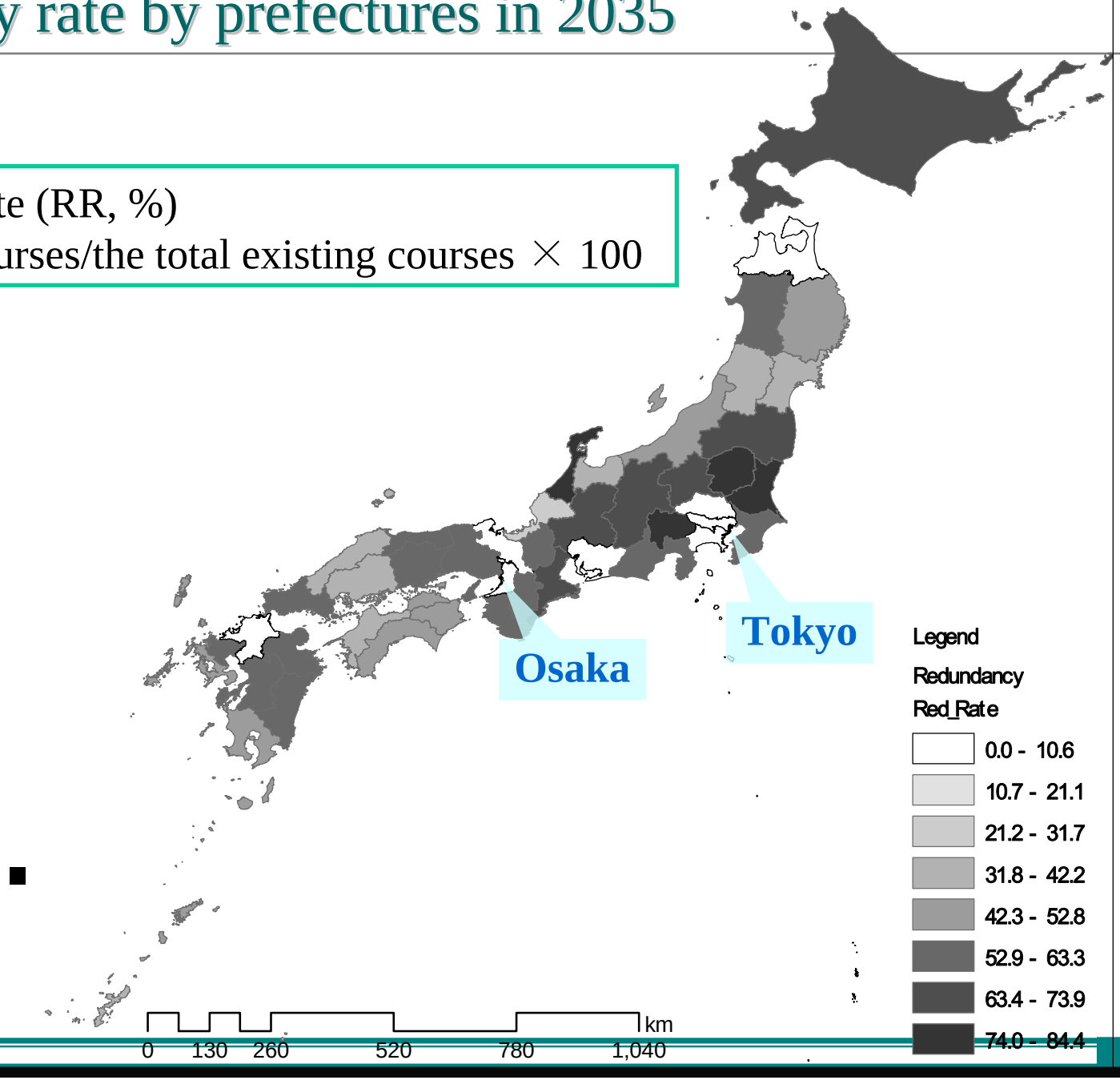
Year	Tokyo Metropolitan Area			National total		
	Number of redundant courses	Redundancy rate (RR) [1)]	Probability of redundancy [2)]	Number of redundant courses	Redundancy rate[1)]	Probability of redundancy [2)]
2005	−51	−7.8%	17.8%	423	17.3%	98.8%
2010	−50	−7.6%	18.4%	438	17.8%	99.1%
2015	8	1.2%	54.5%	610	24.9%	99.9%
2020	43	6.5%	80.1%	727	29.6%	100.0%
2025	69	10.5%	91.4%	814	33.2%	100.0%
2030	105	15.9%	98.1%	917	37.4%	100.0%
2035	**152**	**23.1%**	99.8%	**1,041**	**42.4%**	100.0%

1) Redundancy rate (RR, %) = redundant courses/the total existing courses × 100

2) 'Probability of redundancy (%) is the probability that more than one redundant course will occur among 10,000 trials of Monte Carlo simulation.

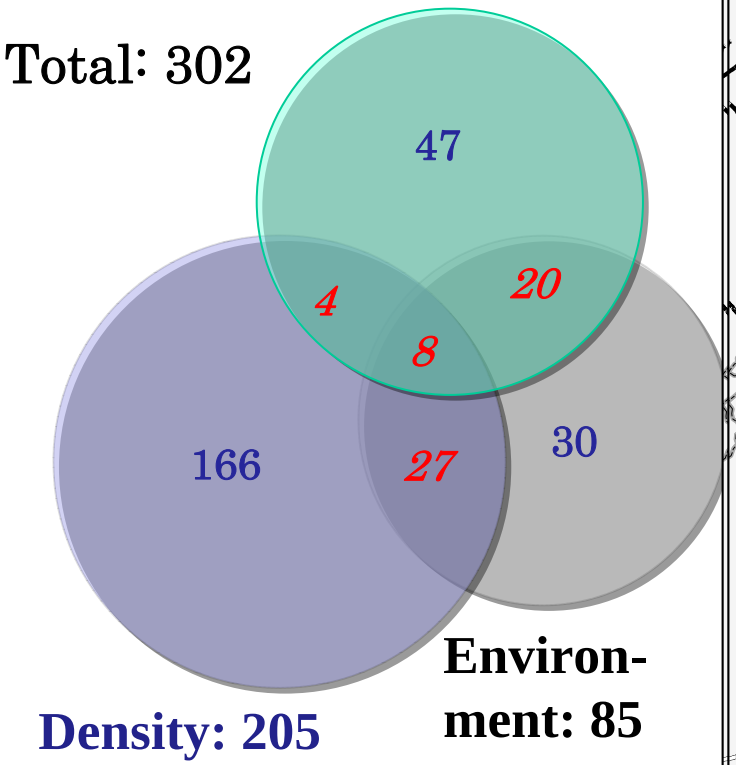
Redundancy rate by prefectures in 2035

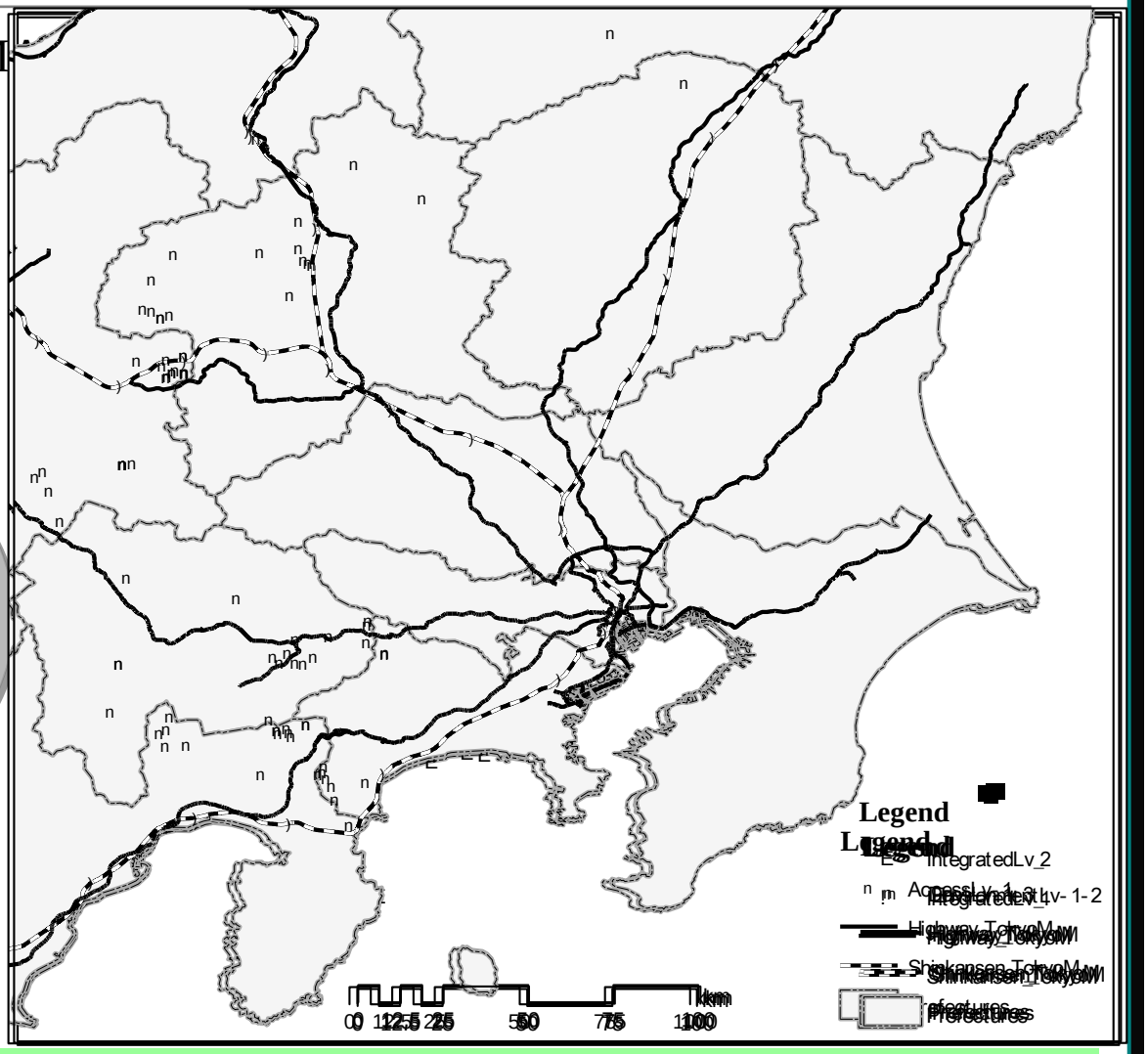
Redundancy rate (RR, %)
= redundant courses/the total existing courses × 100



3.3. Spatial Distribution of Redundant Golf Courses

Out of over 800 courses in Tokyo M





Integrated level 1: Overlapped parts (***bold italic figures***, **59 golf courses**) → ●

Integrated level 2: un-overlapped parts (**243 courses**) → ＋

The closed golf course in Gunma Pref.（2008/05/27)

The closed golf course in Gunma Pref.（2008/05/27)

Dug out by wild boars （2008/06/24)

Seedlings (Recovering to forest ?)

The abandoned clubhouse

Landslide and erosion

3.4 Alternative Management Options for Restructuring Redundant Golf Courses

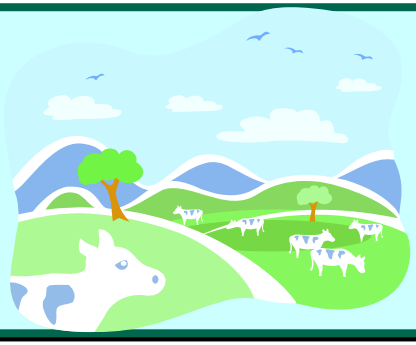
a) Multi-purpose space (park)

b) Cemetery

c) Biofuel feedstock plantation and storage site for biomass feedstock

d) Reforestation

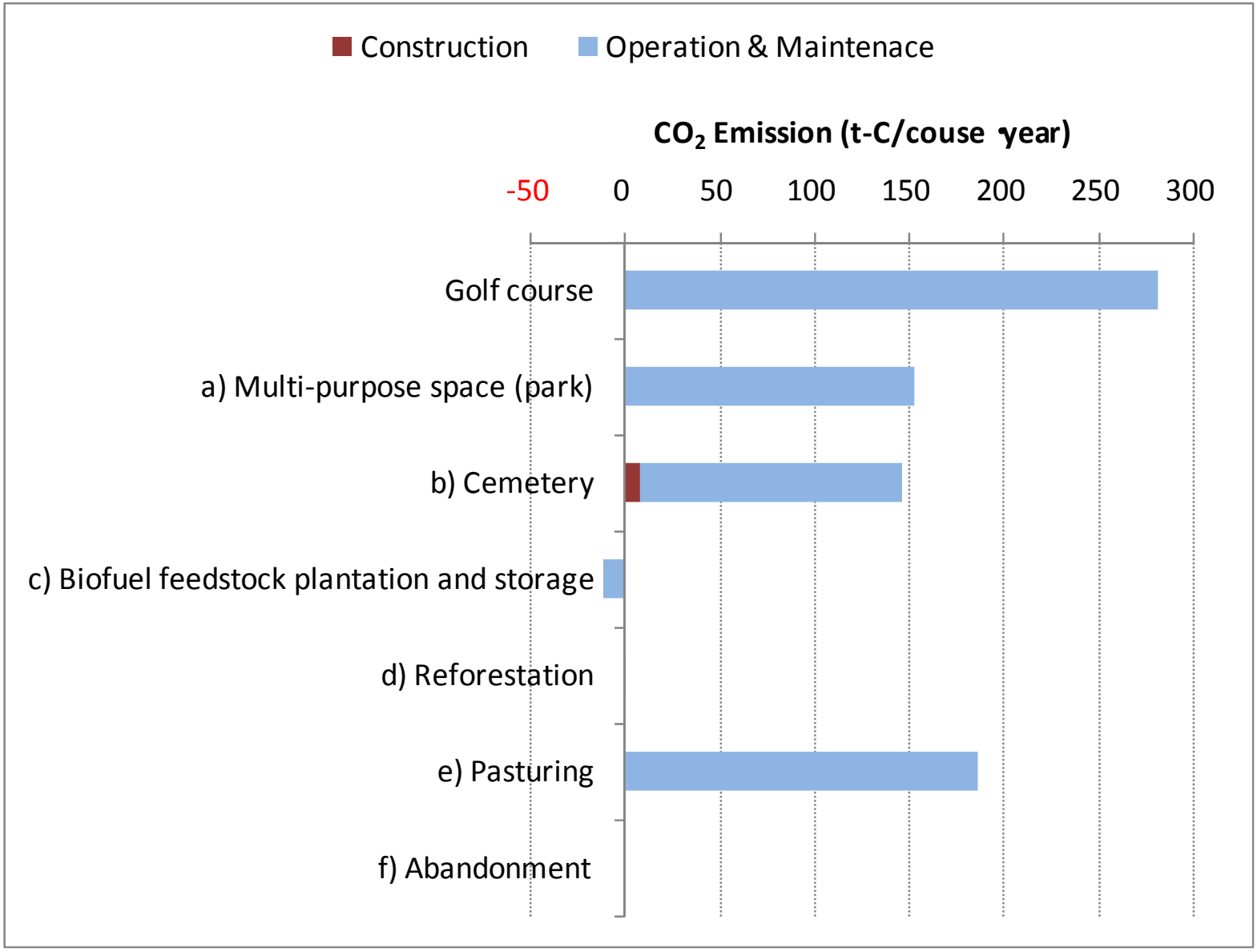
e) Pasturing



f) Abandonment

Options	Environmental impacts	Social and economic impacts
a) Multi-purpose space	The space can be also utilized as a nature restoration site or even a disaster control site	Citizens can enjoy walking, sports and other recreational activities
b) Cemetery	Avoid or minimize additional forest destruction associated with cemetery development	Resolve a deficient cemetery supply in peri-urban areas
c) Biofuel feedstock plantation and storage site for biomass feedstock	A net life cycle CO_2 sequestration of 3.3-4.4 ton ha-1year-1 of CO_2 (Tilman et al., 2006) The redundant courses can supply storage space not only for feedstock of perennials, but also for other cellulosic resources like forest thinning and agricultural residues	Promote rural industry and create employment opportunities
d) Reforestation	Improve biological diversity and enhance carbon sequestration and water-retaining functions as well as restore rural landscape	Fields for action-based environmental education
e) Pasture	Pasturing can deter degradation of the land and other negative impacts caused by abandonment with relatively low cost and labour	Livestock production would provide economic benefit
f) Abandonment	Recovering to forests in the long run. Soil erosion and illegal dumping of industrial waste should be monitored	Damages on agricultural production by wild boars Landslide disaster potential

Estimated GHG Emission of 6 options



4. SUMMARY & FURTHER RESEARCH

- This study
  - reviewed developmental history of golf courses in Japan and estimated that 152 (23%) golf courses will be redundant by the year 2035 in Tokyo MA.
  - identified 302 golf courses that are or will be soon approaching redundancy through the spatial distribution analysis.
  - described six alternative management options for restructuring the existing golf courses as a sustainable infrastructure.
- Further research is required to spatially allocate the proposed 6 options and assess their benefits and risks, using environmental and social data of each potentially redundant course. Undertaking field surveys of vegetation recovery and environmental changes in abandoned golf courses is also needed to improve the management options and their assessment.

Appendixes

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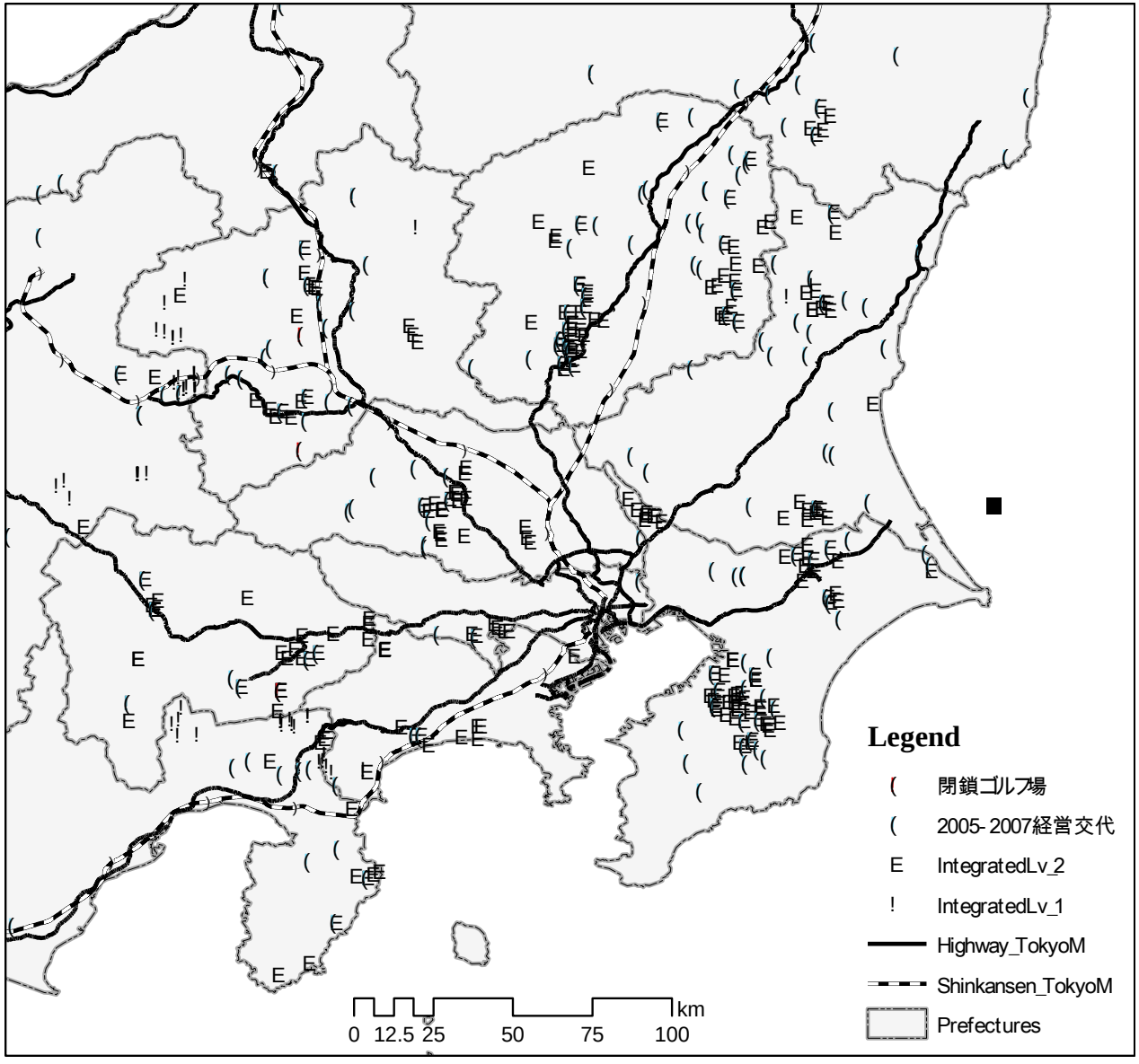
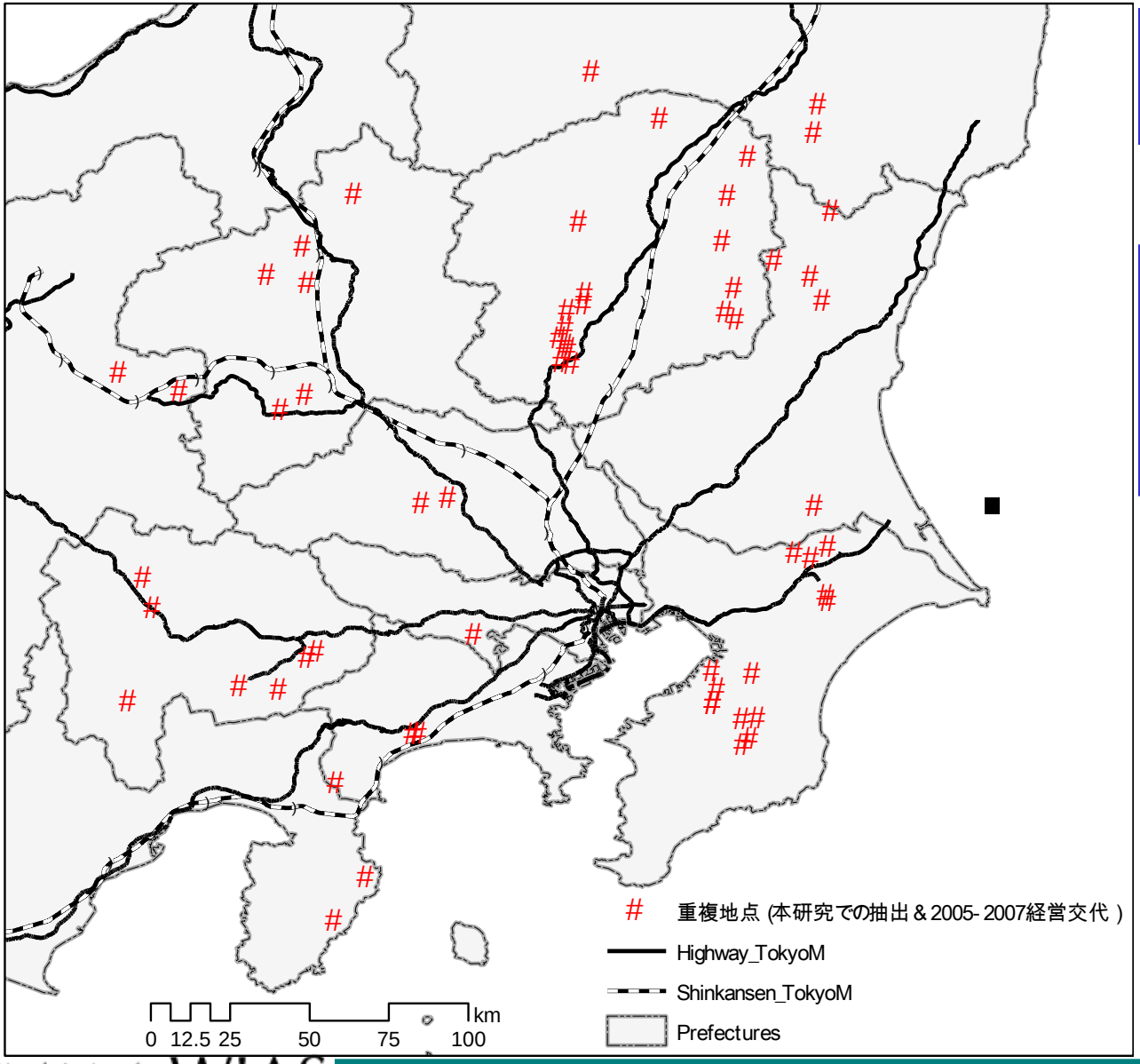
Examination of spatial distribution analysis (1)



● : **Changes in ownership for the last three years (2005-2007)**
…165 courses

63 (21%) courses experienced ownership changes for the last three years out of 302 potentially redundant courses

Examination of spatial distribution analysis (2)



Potentially redundant courses in this study

and

The courses experienced ownership changes for the last three years

▲63 courses