LIEM-Hawaii Meeting
21-22 May, 2009

Rural –Urban Systems and Industrial Ecology:
Case Studies in Japan and Asia

Osamu Saito

Waseda Institute for Advanced Study

Waseda University

Waseda Institute for Advanced Study WIAS

Outline

1. Rural – Urban Systems through Biomass Utilization in Asia

(1) Urban-Rural Linkages through Biomass Utilization in Asia

(2) Key Issues on Rural Urban Systems in Asia

2. Changes in Biomass Material Flow

(1) Biomass material flow in Vietnam's Mekong Delta

(2) Biofuel production in Malaysia

(3) Biomass material flow in Japan

3. Agricultural landscape and ecosystem services in Japan

(1) *Satoyama* (Japanese traditional agricultural landscape) and its ecosystem services in Japan

(2) Changes in *Satoyama* and ecosystem services

4. Sustainability of Resort Industry in Japan

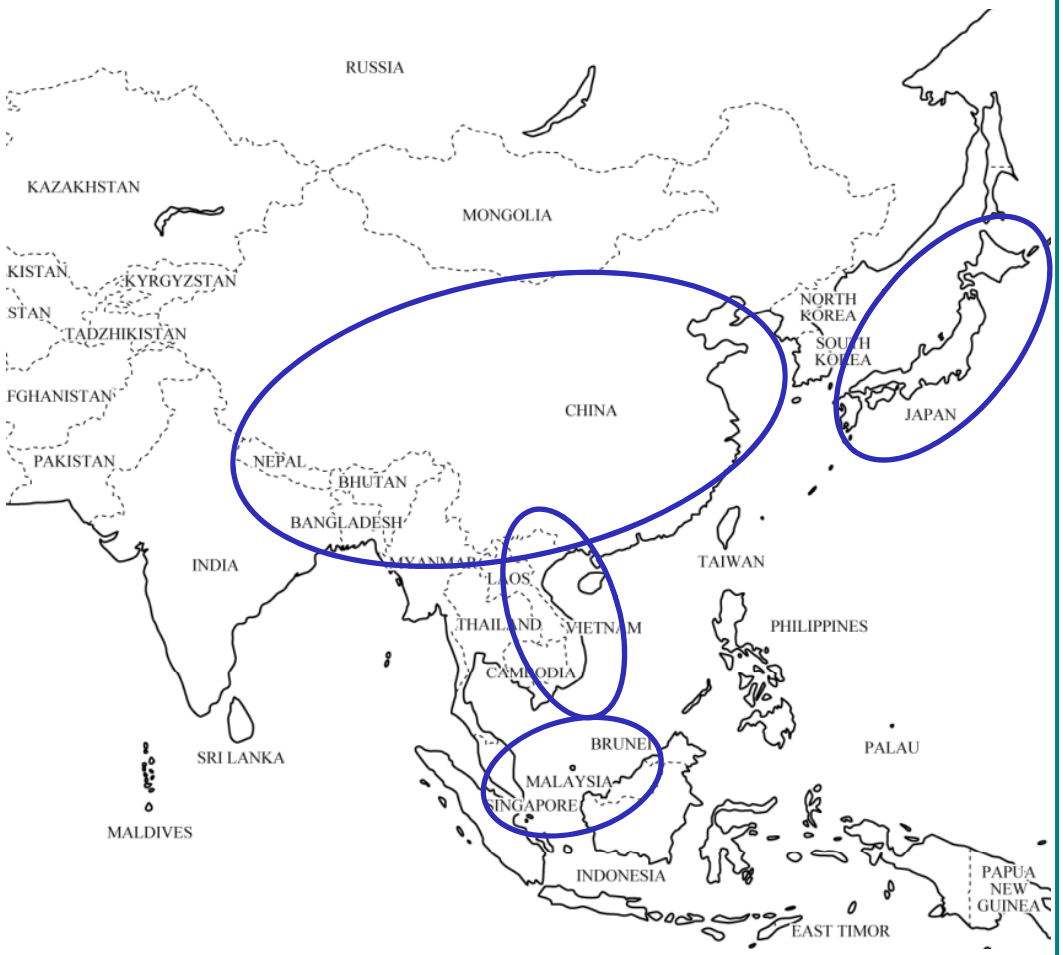
(1) Resort development in the Tokyo Metropolitan Area

(2) Redundant golf courses

(3) Restructuring the redundant golf courses and its environmental and social impacts

Rural – Urban Systems through Biomass Utilization in Asia

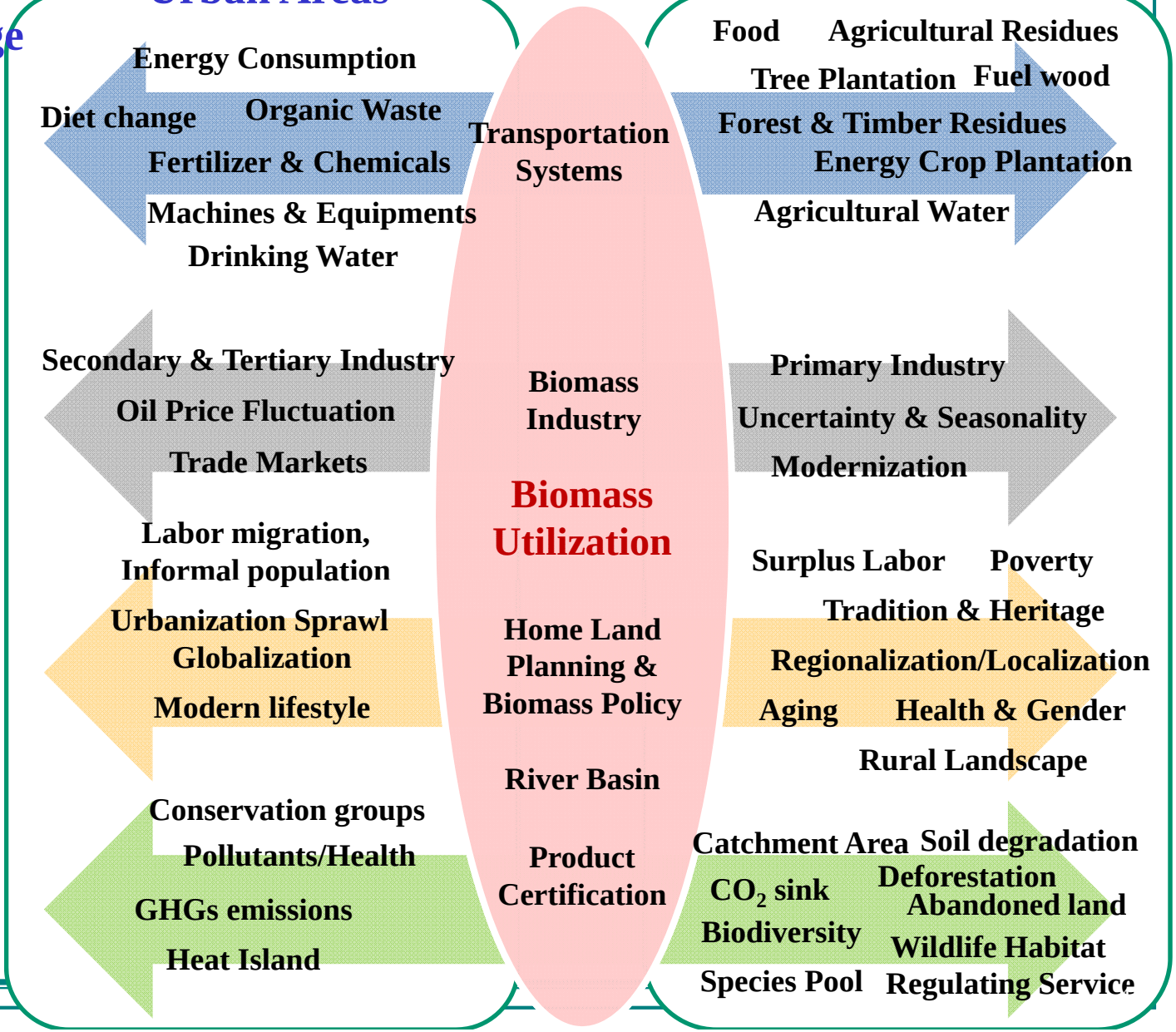
- While the world-wide demand for biomass such as biofuel made of corn, sugarcane and oil palm is growing, it is predicted that unused agricultural residues and abandoned arable land may increase in developing countries due to changes in diet and rural farming systems.
- Biomass use matters relationship between rural and urban areas not only through material and energy exchanges, but also through history, culture, tradition and social context of each region or country.



Urban-Rural Linkages through Biomass Utilization:

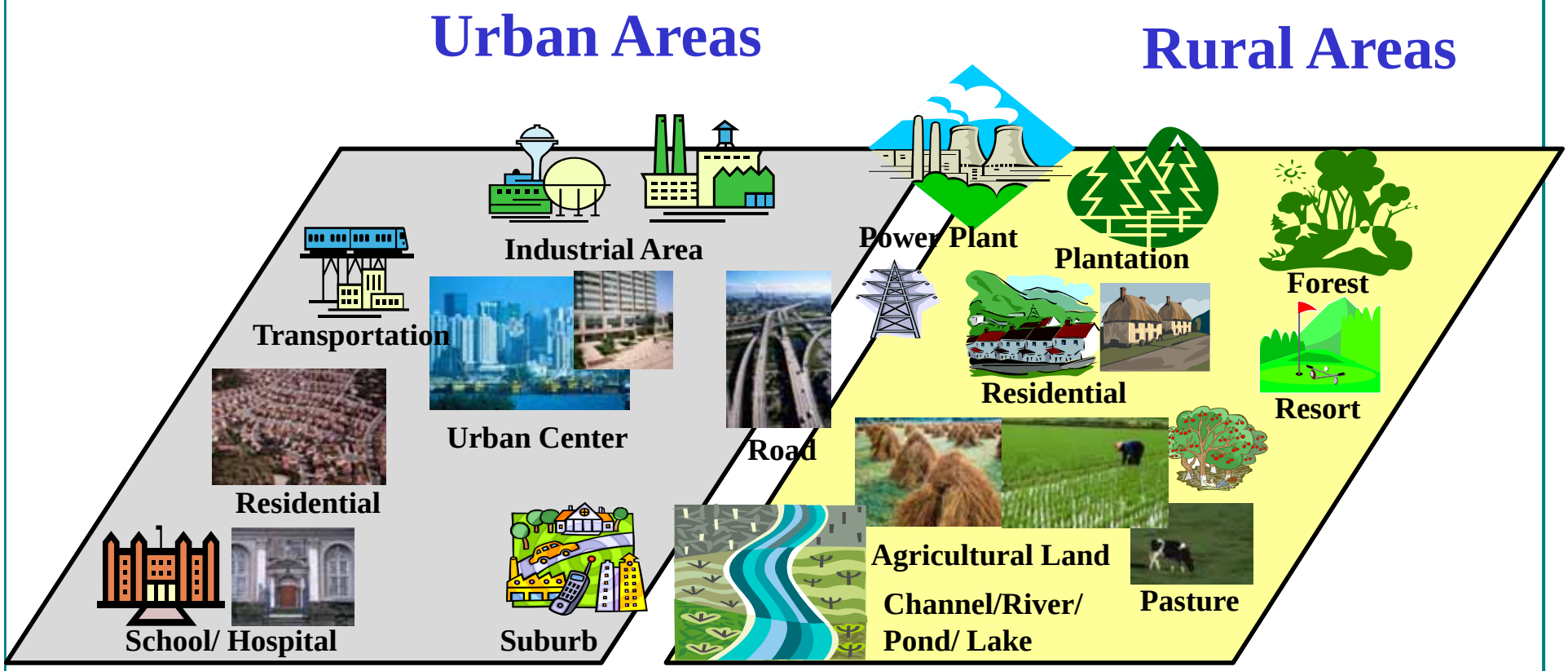
Four Layers of Urban-Rural Linkage

- Energy & Resources
- Economy & Industry
- Socio-Culture
- Ecosystem & Environment



Waseda Institute for Advanced Study WIAS

In terms of Land Use:



Issues

Four Layers of Urban-Rural Linkage

Major issues

Energy & Resources

1) Food and Bioenergy
2) Waste and Bioenergy
3) Water
4) Motorization

Economy & Industry

5) Economic Growth and Industrial Structure
6) Globalization and Regionalization
7) Technology Development and Diffusion

Socio-Culture

8) Individualism and Social Integration
9) Urbanization and Symbolic Rurality
10) Rural Abandonment

Ecosystem & Environment

11) Coheision and Fragmentation
12) Environmental Sustainability
13) Regulation and Certification

Key Issues regarding Rural-Urban Systems:

Common issues ➔ Energy and resources management, globalization and economic growth (Economy &Industry)

Key issues for Japan

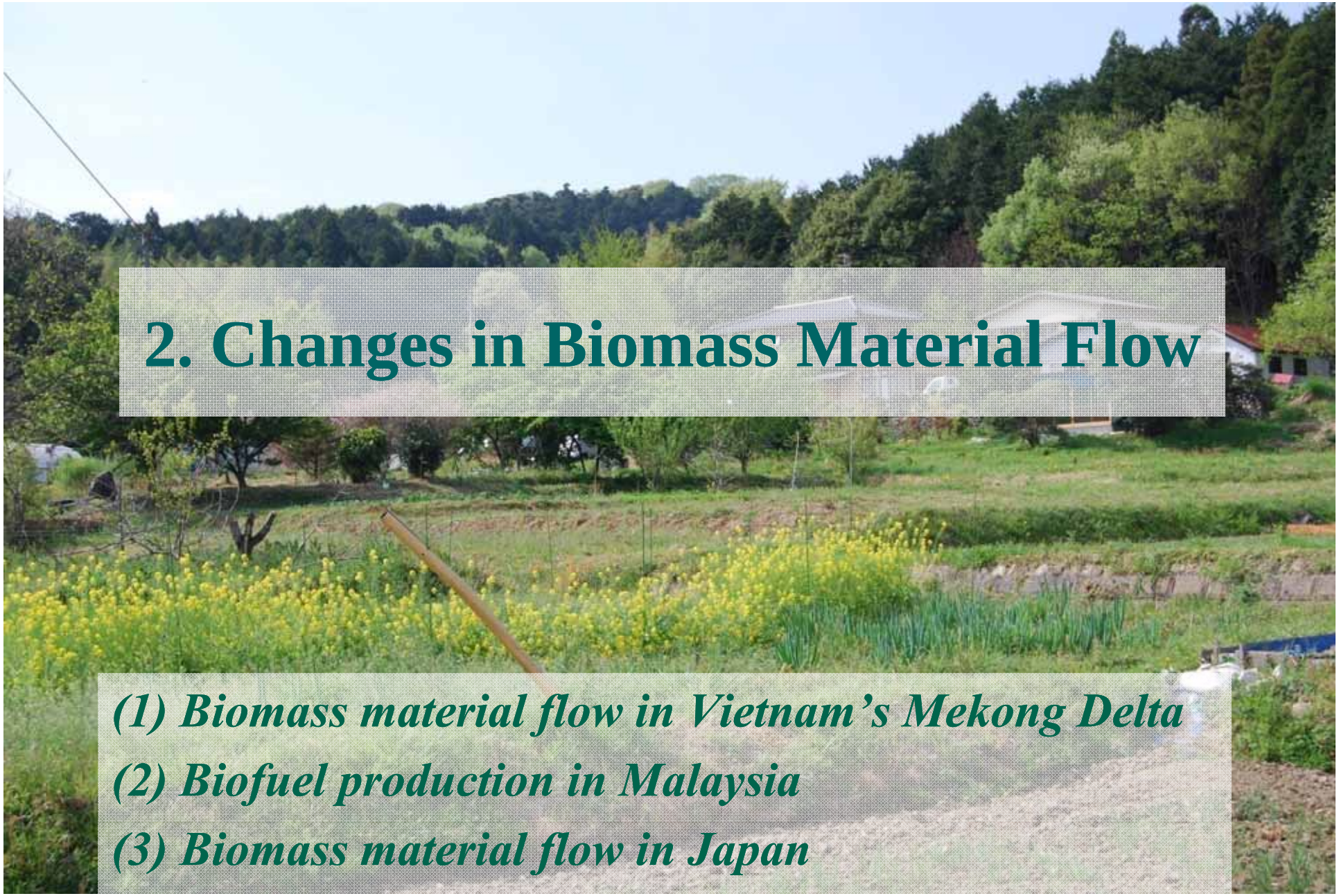
➔ **Rural abandonment, symbolic rurality, fragmentation, redundancy of rural infrastructures, accumulated large forest biomass stock and high dependency on timber and food imports**

Key issues for China

➔**Increase in biomass waste (agricultural residues and MSW) , water shortage, motorization, industrial structure and lifestyle changes, rapid urbanization and labor migration from poor rural areas**

Key issues for Vietnam

➔ **Similar to China, but almost a decade behind China. Food, waste, motorization (especially motorcycles) , industrial structure, urban sprawl and basic infrastructure construction and technology diffusion**



2. Changes in Biomass Material Flow

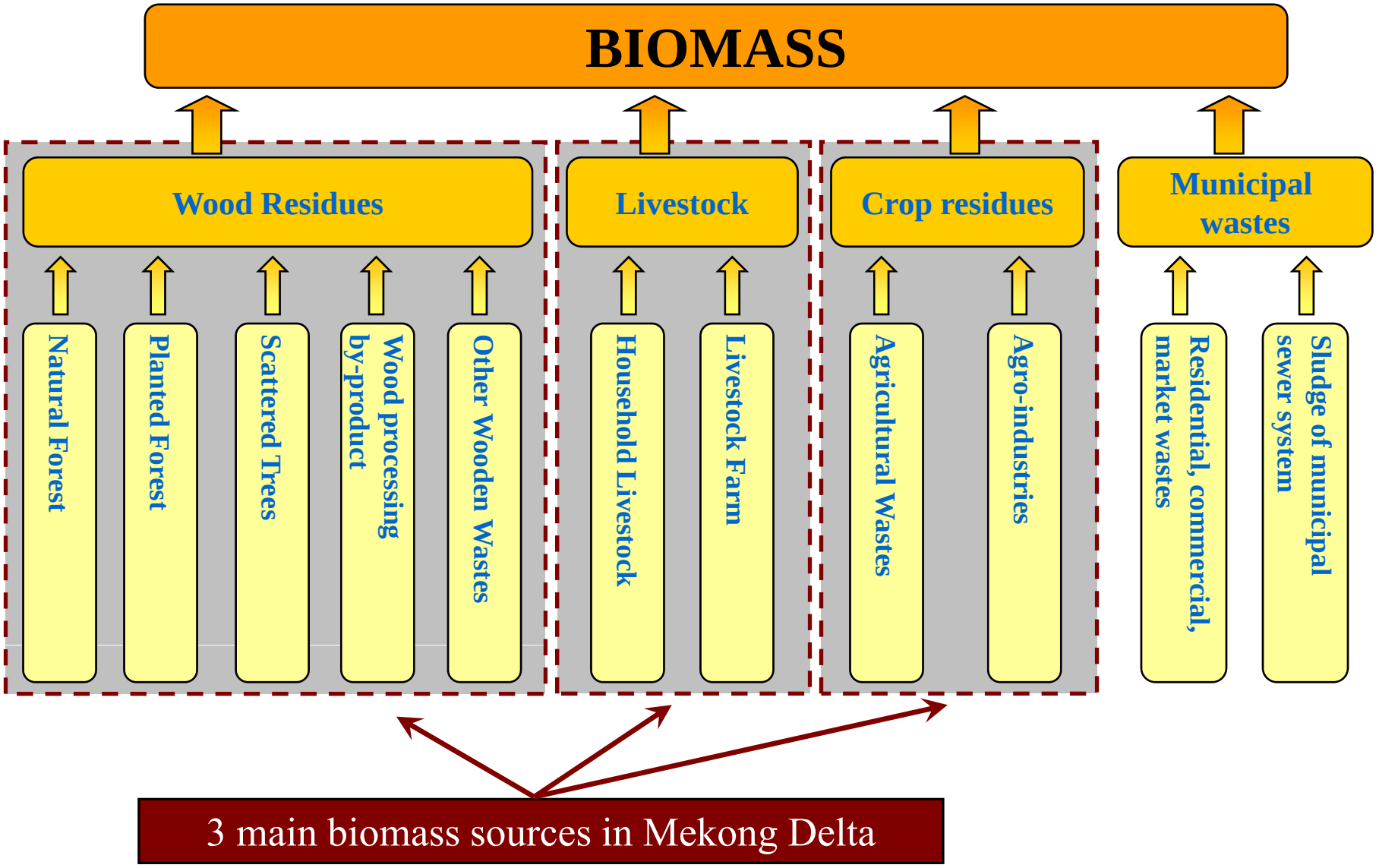
(1) Biomass material flow in Vietnam's Mekong Delta

(2) Biofuel production in Malaysia

(3) Biomass material flow in Japan

(1) Material flow of biomass in Vietnam's Mekong Delta

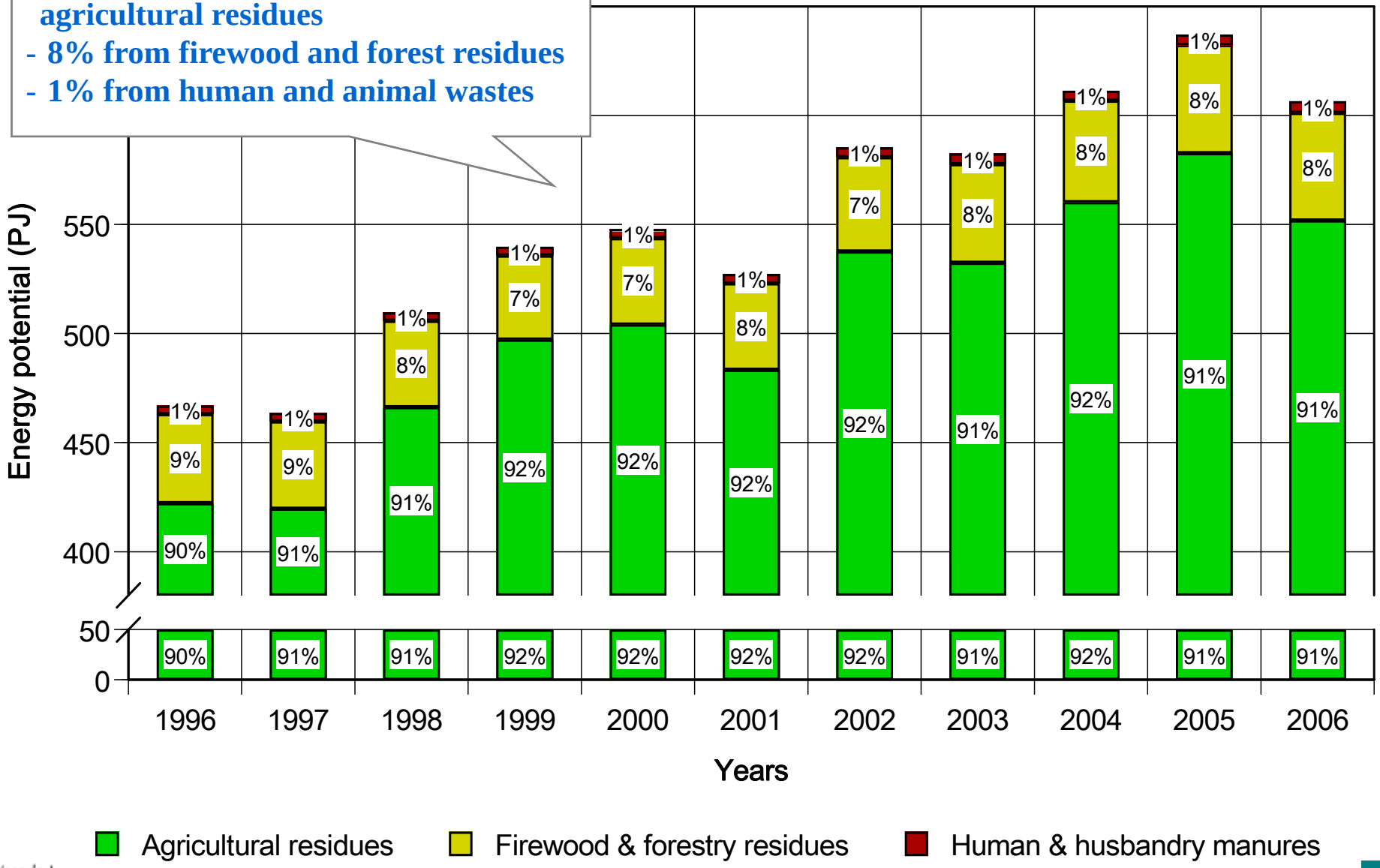
Major biomass sources in Vietnam



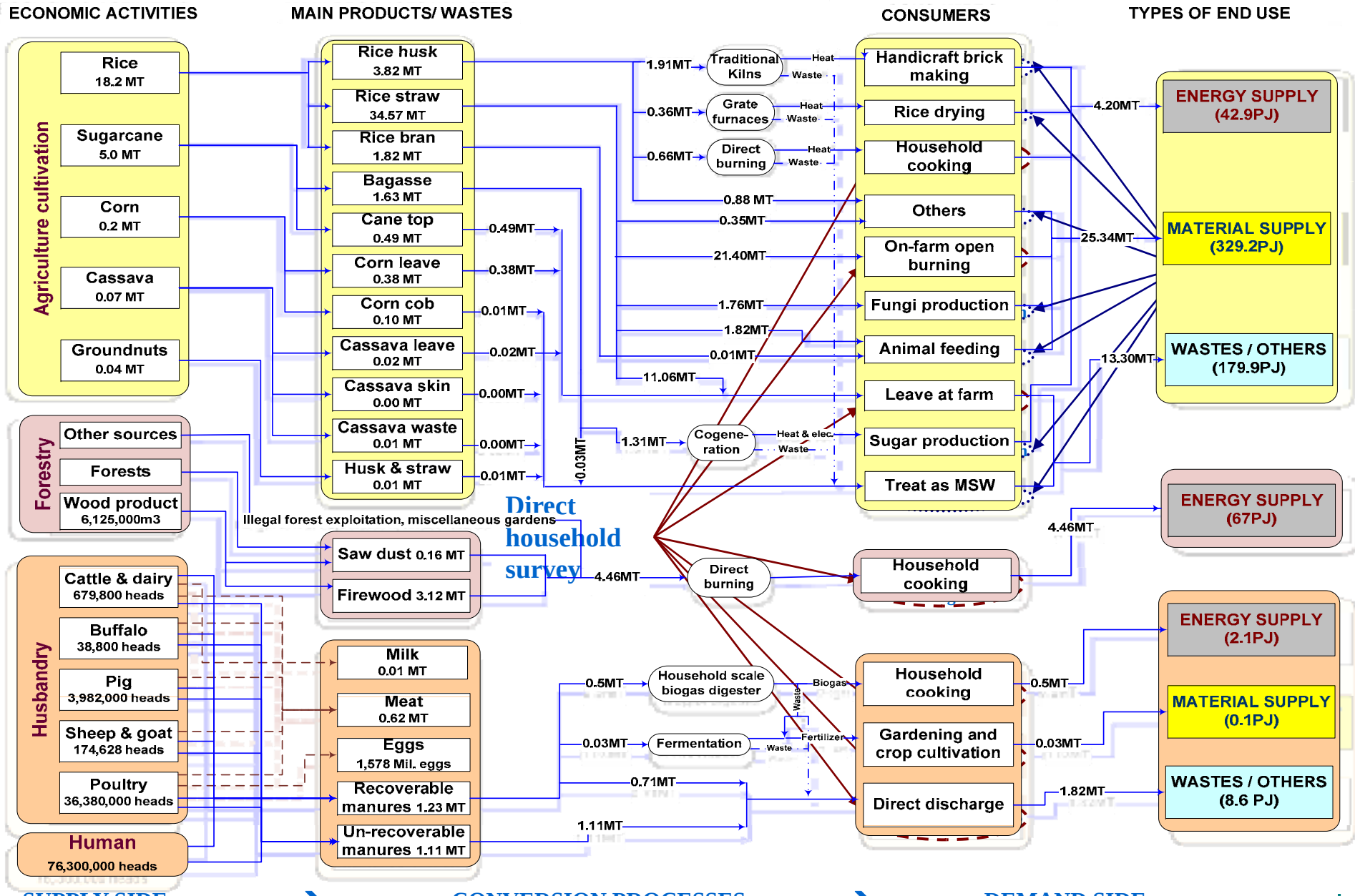
Source: N.H.Chan – Present status on biomass energy research and development in Vietnam – 2nd Biomass Asia Workshop, 2005

Biomass energy potential in Mekong Delta

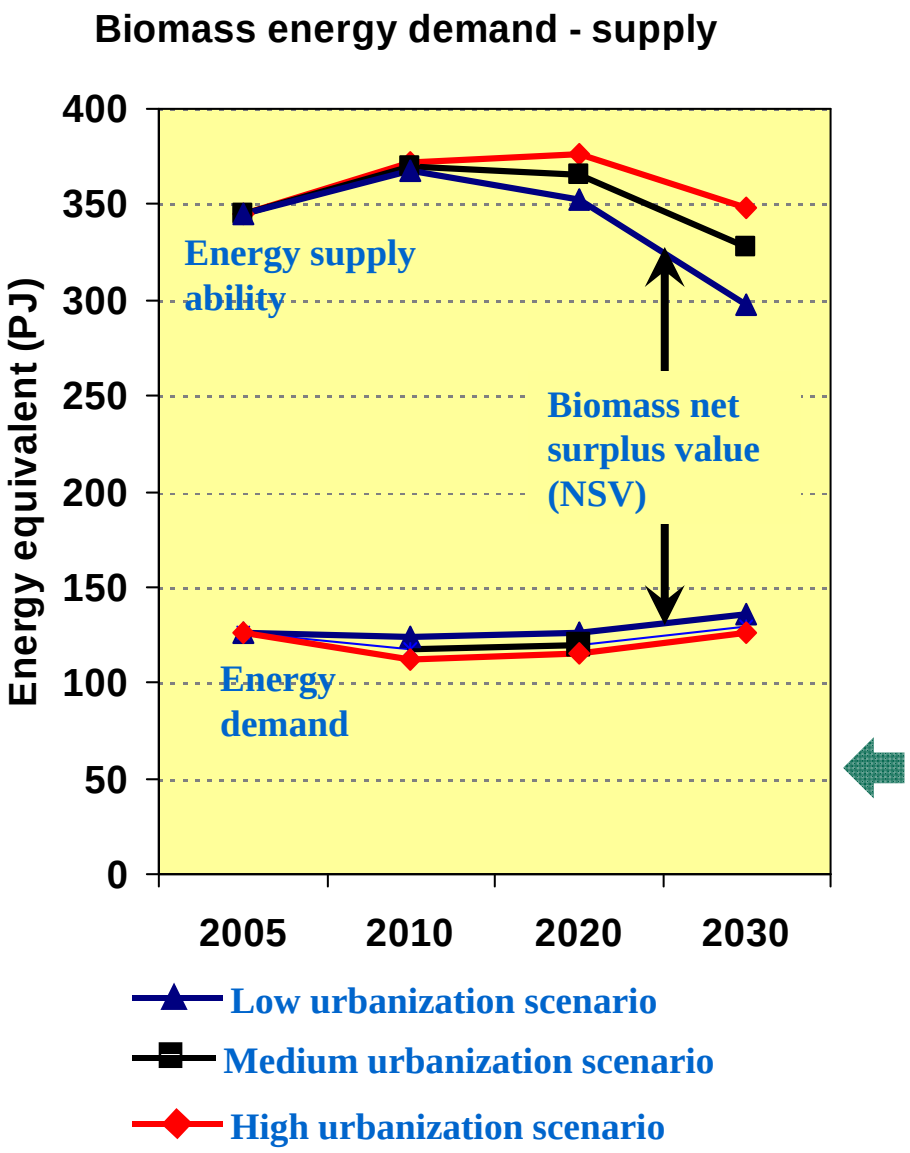
- 91% energy potential comes from agricultural residues
- 8% from firewood and forest residues
- 1% from human and animal wastes



Biomass material flow in Mekong Delta



Biomass potential and consumption projection



Rice husk and rice straw are not fully utilized

- *low density* characteristic
- *Scattered* sources

➔ Difficult to collect, handle and store

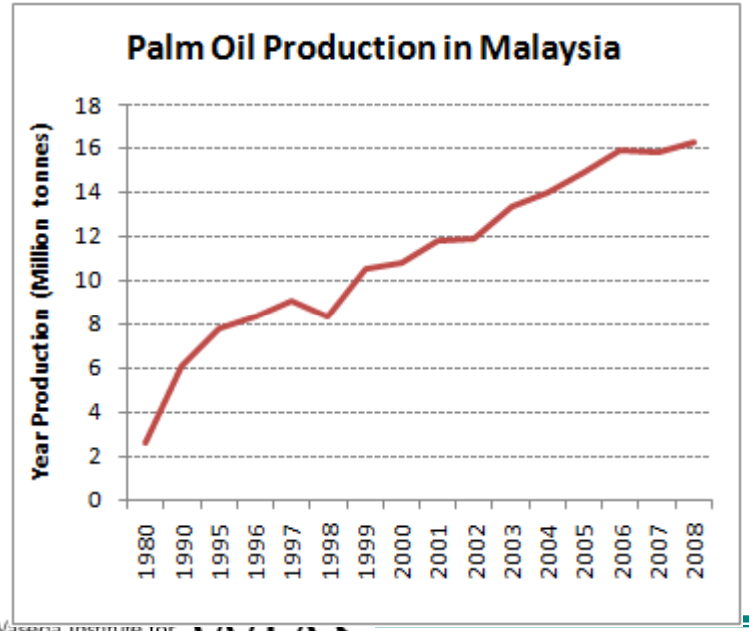
➔ High transportation cost

Insufficient handling and utilization ➔ negative impacts on the environment

Depending on the extent of urbanization, biomass-based energy supply will decrease by 3.1 – 22.2% in 2030

(2) Biofuel production in Malaysia

- Palm oil is the most produced vegetable oil in the world in terms of production – 37 million tones (Oil World, 2006)
- Malaysia and Indonesia account for 86% of global palm oil production



Roundtable on Sustainable Palm Oil (RSPO)

RSPO's Principles and Criteria (P&C):

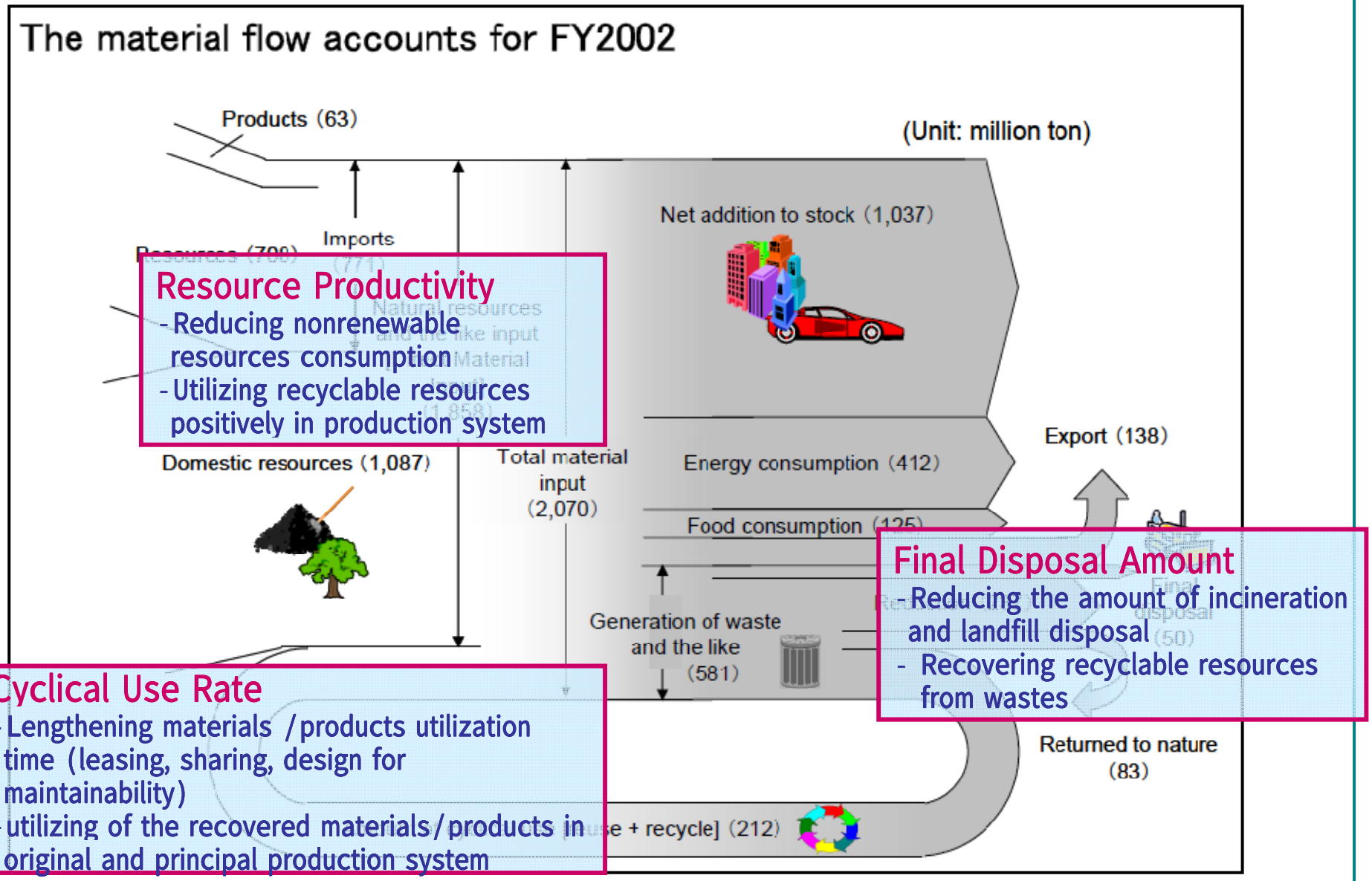
1. Commitment to transparency
2. Compliance with application laws and regulations
3. Commitment to long-term economic and financial viability
4. Use of appropriate best practices by growers and millers
5. Environmental responsibility and conservation of natural resources and biodiversity
6. Responsible consideration for employees and for individuals and communities affected by growers and mills
7. Responsible development of new plantings
8. Commitment to continuous improvement in key areas of activity

- RSOP certified palm oil entered market in September 2008 and close to 1.5 million tones are expected to be in the market by end 2008. The volume will reach 2 million tones by the end of 2009, which accounts for 5 % of the world palm oil production .
- RSPO membership: 264Ordinary and 92 Affiliate members (as of May 2009), accounting for 40% of palm oil production in the world

Volumes of RSPO certified palm oil to April 2009

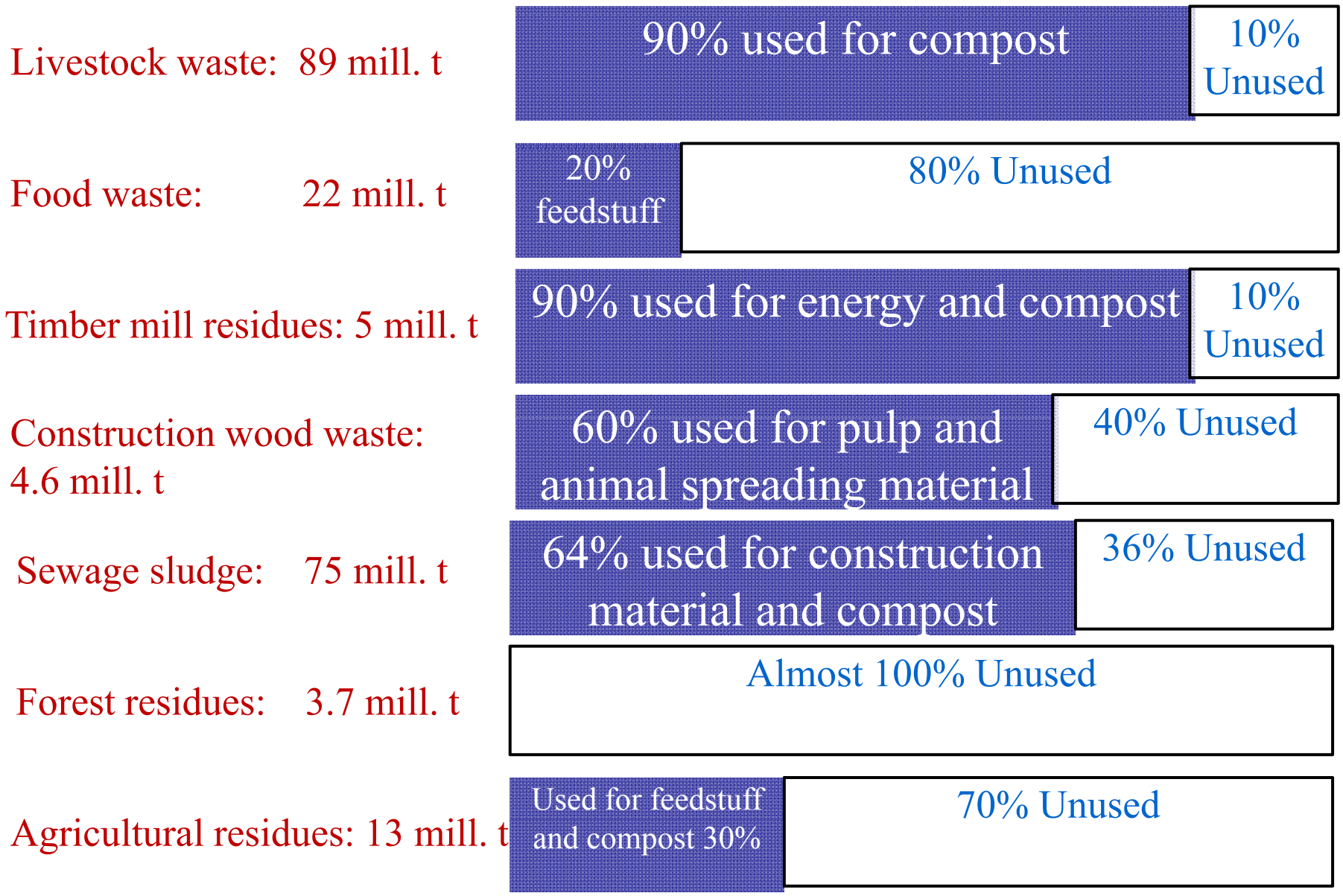
Company	Country	Mills	CPO (mt)	PK (mt)
United Plantations Berhad	Malaysia	6	185,324	50,195
New Britain Palm Oil (NBPOL)	PNG	4	257,338	62,181
Sime Darby	Malaysia	5	218,636	52,823
Kulim Bhd	Malaysia	3	88,914	24,943
Wilmar/PPB Oil Palms	Malaysia	3	122,900	27,400
PT Musim Mas	Indonesia	2	135,000	31,250
IOI Corp	Malaysia	1	70,000	16,500
SIPEF/ Hargy Oil Palms Ltd	PNG	2	180,122	41,000
Cargill/PT Hindolie	Indonesia	2	51,344	12,122
Kuala Lumpur Kepong-KDC	Malaysia	2	92,000	22,000
PT London Sumatra	Indonesia	4	169,480	PKO
TOTAL		34	1,571,056	340,414

(3) Material flow of biomass and its changes in Japan

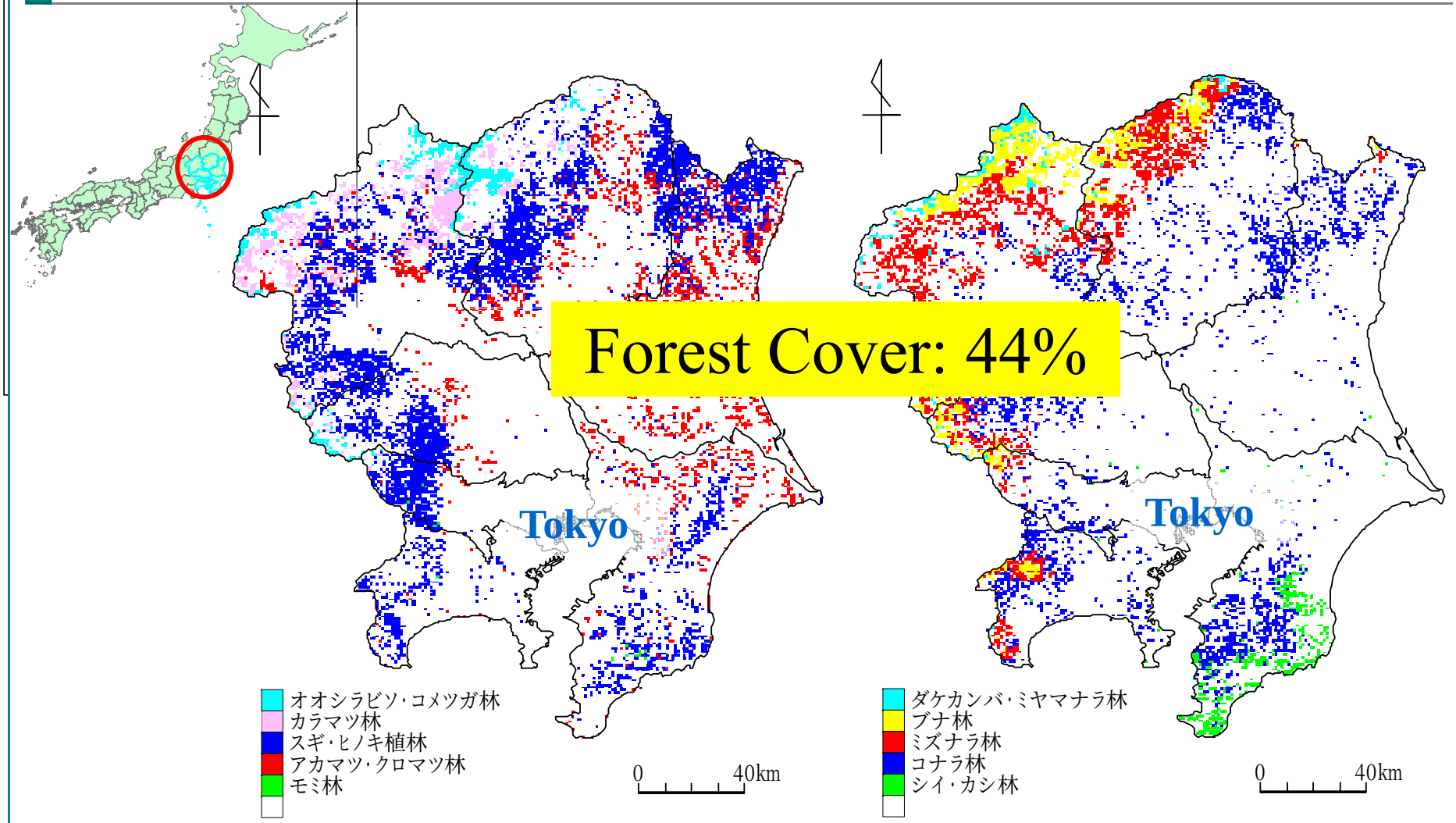


Ministry of the Environment: Fundamental Plan for Establishing A Sound Material-Cycle Society, <http://www.env.go.jp/en/rep/waste/plan_sound.pdf>

Major biomass waste emission and utilization in Japan(2005)



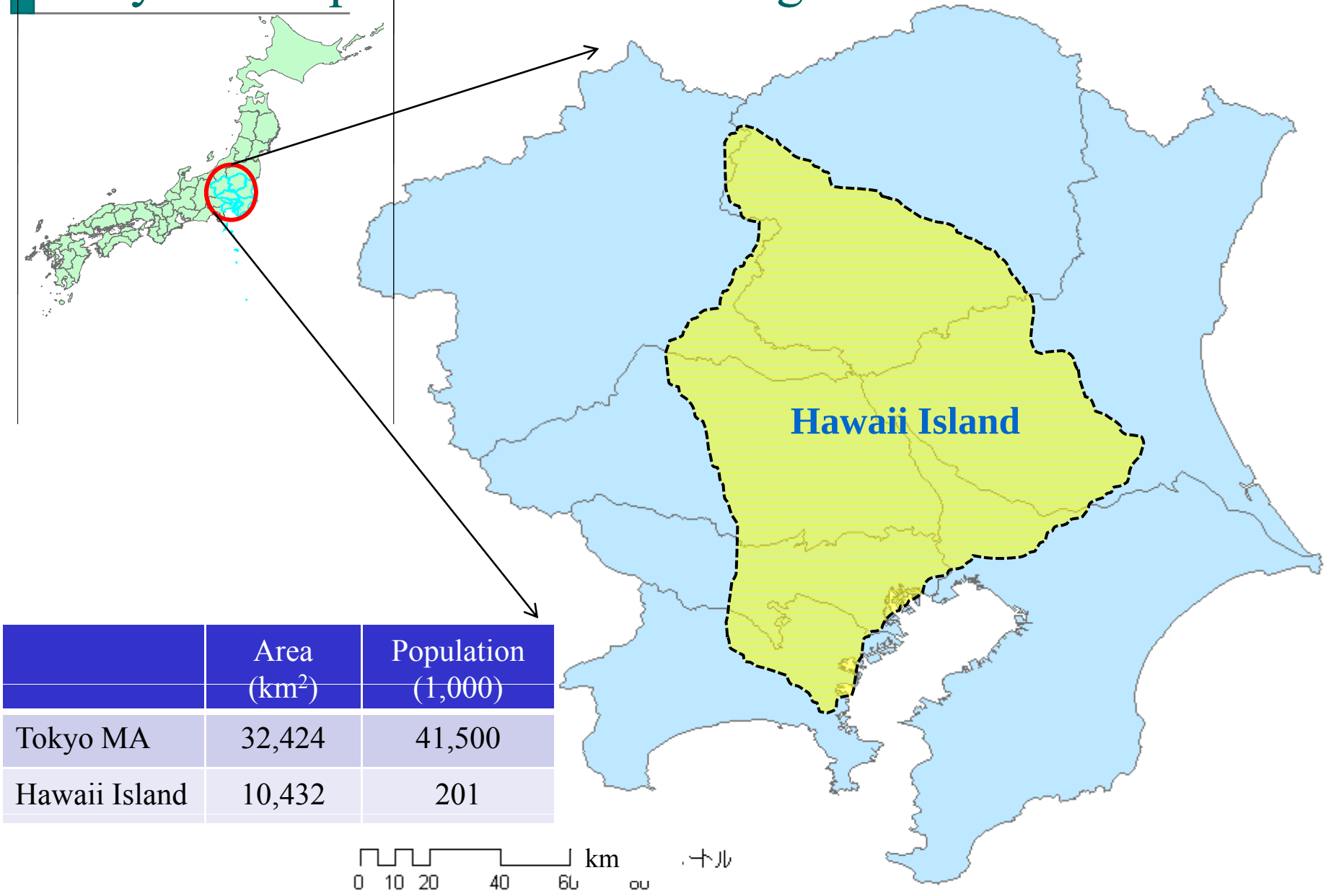
Forest covers in Tokyo Metropolitan Area



Coniferous woodland

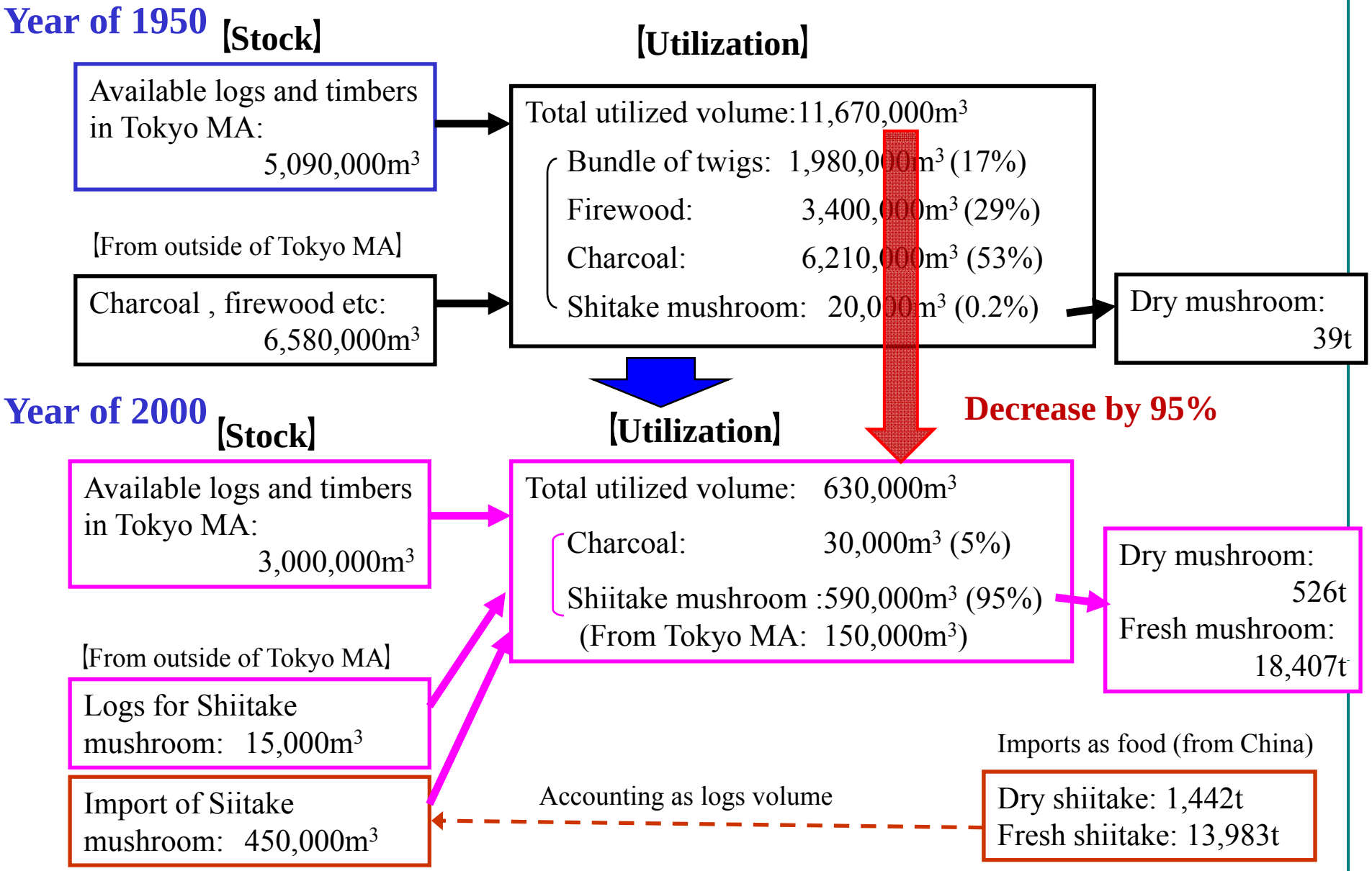
Broad-leaved woodland

Tokyo Metropolitan Area and “Big Island”



	Area (km^2)	Population (1,000)
Tokyo MA	32,424	41,500
Hawaii Island	10,432	201

Material flow changes in secondary woodland

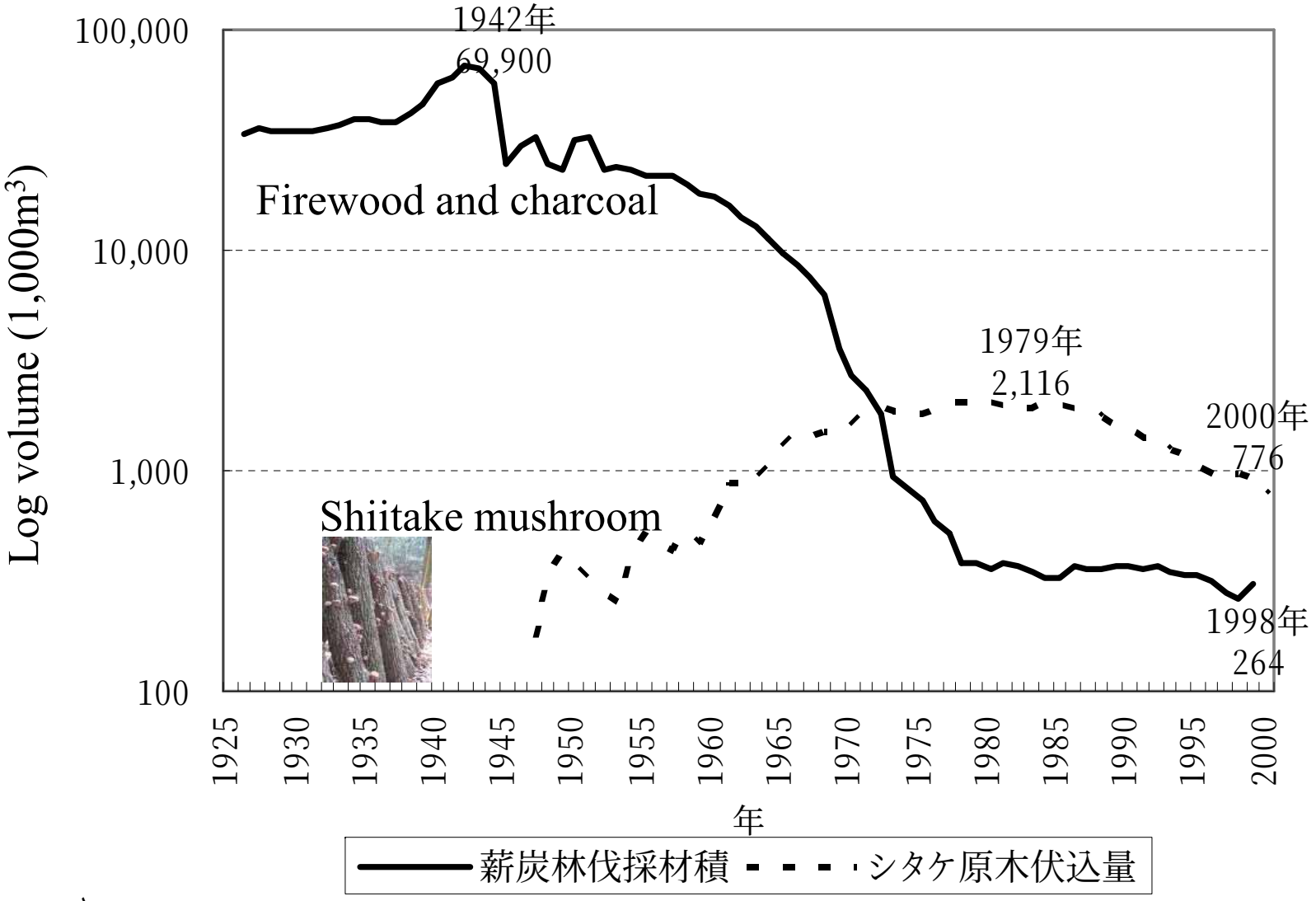


Shiitake Mushroom Production in Tokyo MA (2001)

Fresh Shitake Mushroom

Dry Shitake Mushroom

Long-term changes in logs volume for firewood, charcoal and shiitake mushroom in Japan



(Source) Japanese Agency of Forestry

3. Agricultural landscape and ecosystem services in Japan

(1) Satoyama (Japanese traditional agricultural landscape) and its ecosystem services in Japan

(2) Changes in Satoyama and ecosystem services

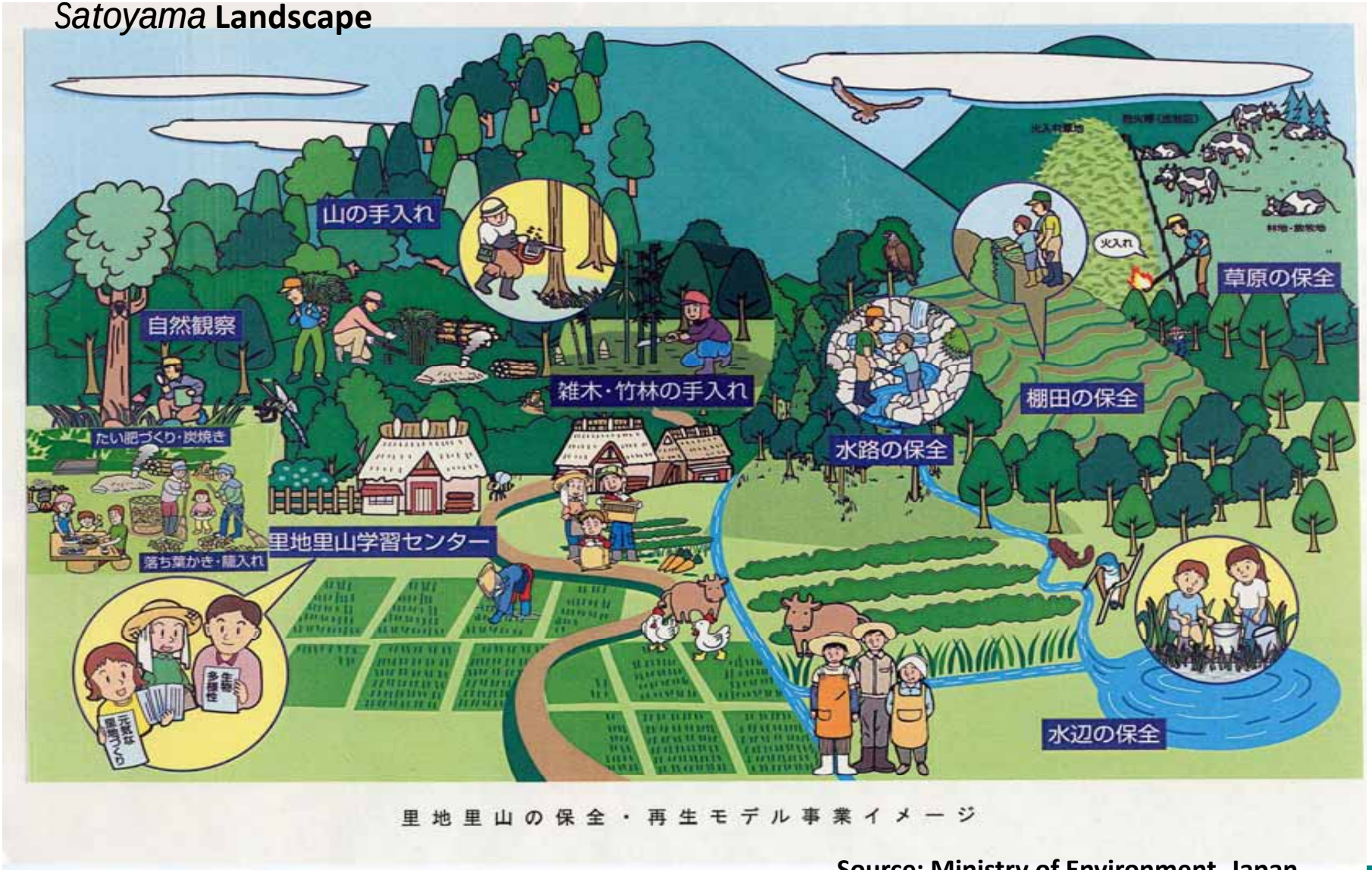
What are *Satoyama*

Satoyama≈ Japanese term for traditional rural landscapes

- Comprises **human settlements and several types of ecosystems**
  - secondary forests, agricultural lands, irrigation ponds, grasslands, etc.
- Formed/developed through **prolonged interaction between humans and ecosystems.**
- Connotes a **traditional way of life**
  - **Interaction is central to the management** of the ecosystems
- More than **40 per cent of Japan's total landmass**
  - many found in rural districts
- Conceptual issues
  - Various terminologies, different definitions, no appropriate English translation

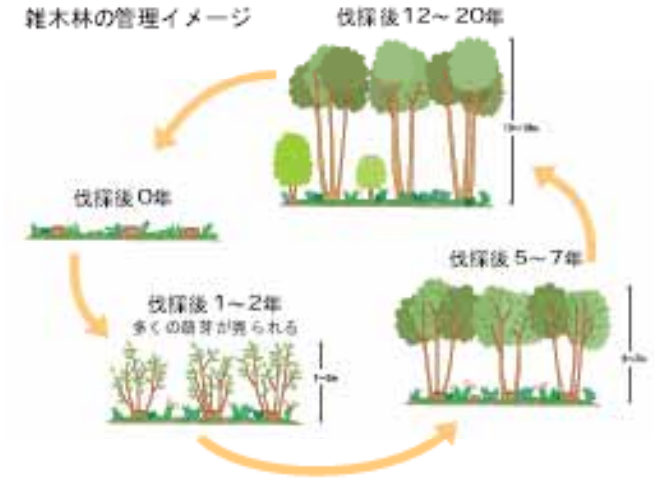
What are *Satoyama* and *Satoumi*?

Satoyama **Landscape**



Source: Ministry of Environment, Japan

Coppice Woods



http://www.env.go.jp/nature/satoyama/pamph/index.html

Ecosystem Services from *Satoyama*

Provisioning Services	Regulating Services	Supporting Services	Cultural Services
- Rice - *Sake* - Fish - Wild edible plants - Charcoal - Bamboo shoots (*takenoko*) - Mushrooms (e.g. *Matsutake*, *Shitake*) - Genetic resources - Medicinal plants - Berries - Bush meat - Timber - Water, etc.	- Climate control (in Japan) - Local air quality control - Flood control - Erosion control - Landslide control - Water quality control - Water filtration - Control of wild animals Population - Pest control - Habitat for migrating birds - Pollination control - Buffering against acid rain and dust, etc.	- Nutrient cycling - Groundwater supporting - Carbon storage, etc.	- Eco-tourism - Traditional knowledge - Symbols and heritage of Japanese culture - Spiritual monuments and objects (e.g. temples, mountains) - Folklore - Festivals *(Matsuri)* - *Amasan* (traditional female divers), etc.

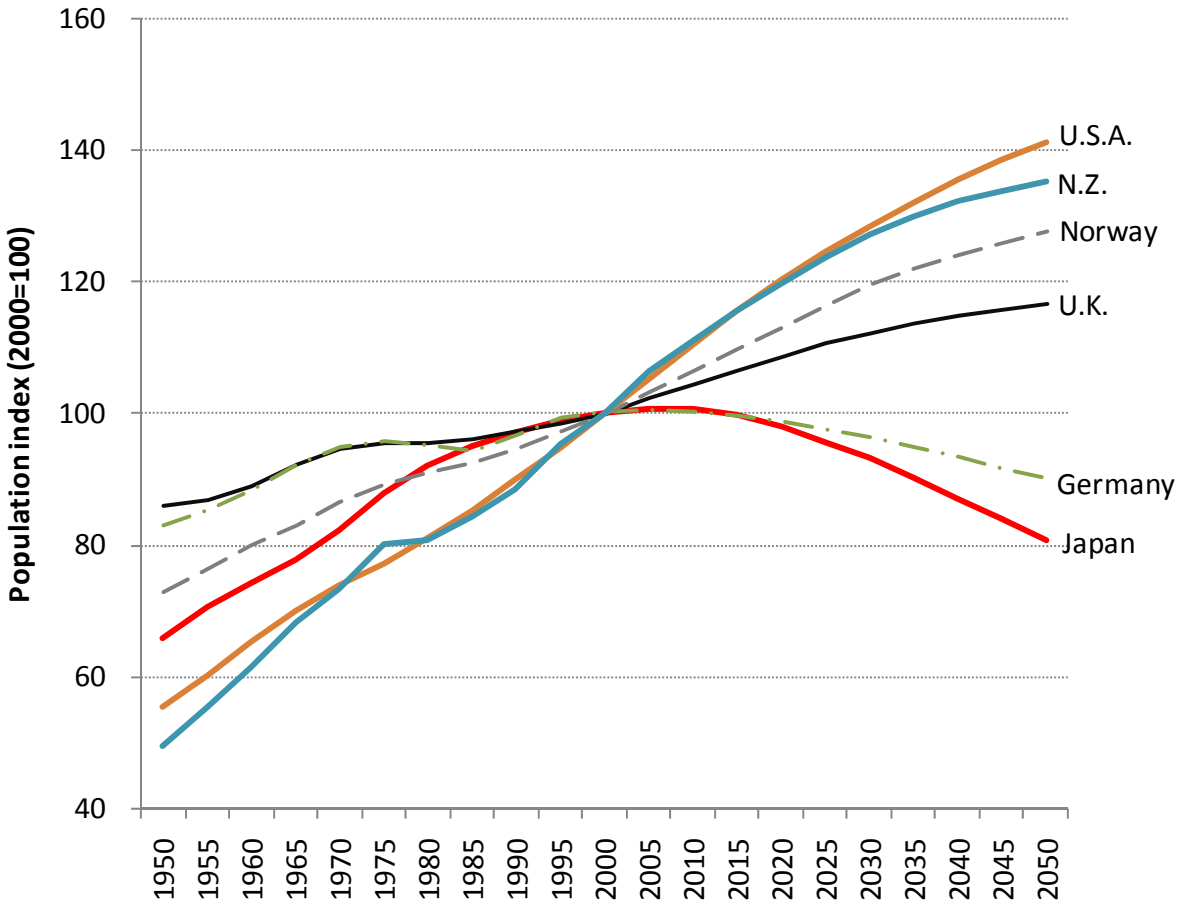
Crises of *Satoyama*

Satoyama is declining and disappearing

Drivers of change (multiple causes):

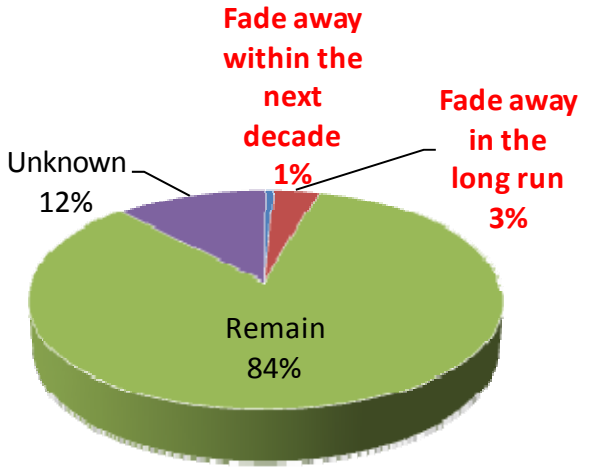
- **Abandonment**
- **Ageing**
- **Depopulation and Rural-Urban migration (out-migration of younger workforce)**
- Declining economic value of agro-forestry products
- Global trade
- Shifting trends in energy consumption (since energy revolution of 1950s)
- Urbanization, construction and development
- Invasive Alien Species (e.g. Black bass).
- Change in sense of commons: Unclear property rights and stronger expression of rights and interest in what was considered as commons

Depopulation and Rural Abandonment in Japan



Fading Rural Settlements:

- 4,849 rural settlements (3.4% of total settlements) have less than 9 households, and 1,403 settlements among them are expected to lose the remaining households (fading away). [1)]
- Out of 62,271 rural settlements in the depopulated regions, 442 settlements (0.7%) will be abandoned within the next decade and 2,219 settlements (3.6%) will fade away in the long run.[2)]



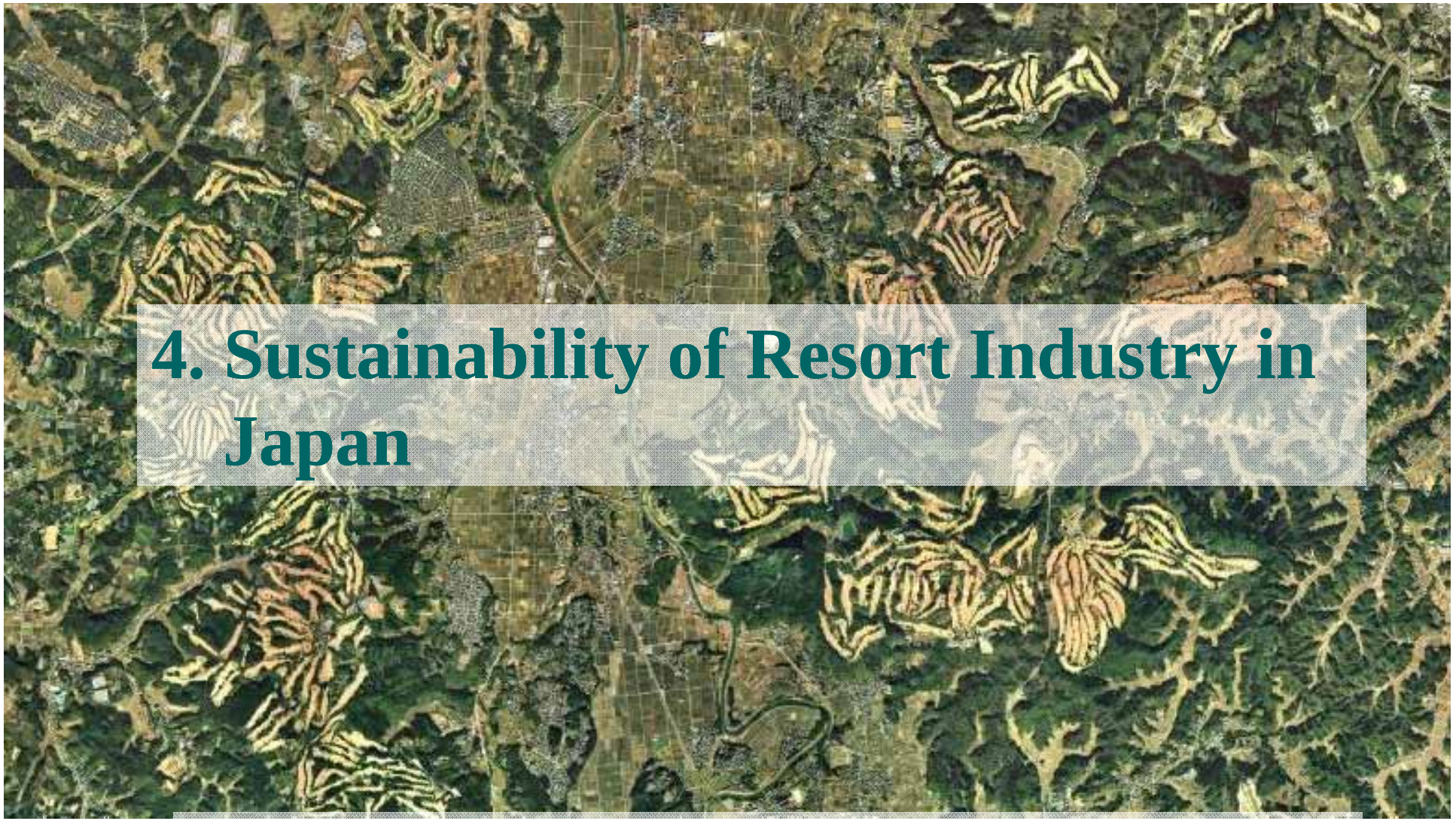
1) Ministry of Agriculture, Forestry and Fisheries, 2006)
2) Ministry of Land, Infrastructure, Transportation and Tourism, 2007)

Consequences of Change

Function, use and value will diminish with the decline and disappearance.

- Impact on national / local economy.
  - *e.g., food: self-sufficiency rate of vegetables in Japan declined from 100% in 1965 to 82% in 2003, and that of mushrooms does from 115% to 77% in the same period (Japan MAFF, 2004).*
- Loss of biodiversity.
- Erosion of cultural heritage: traditional knowledge, diet culture, festivals, etc.
- Disasters (attacks by bears, destruction to food crops by monkeys).
- Increasing the gap between rural and urban areas.

Gap between fine ecological studies and studies on ecosystem services



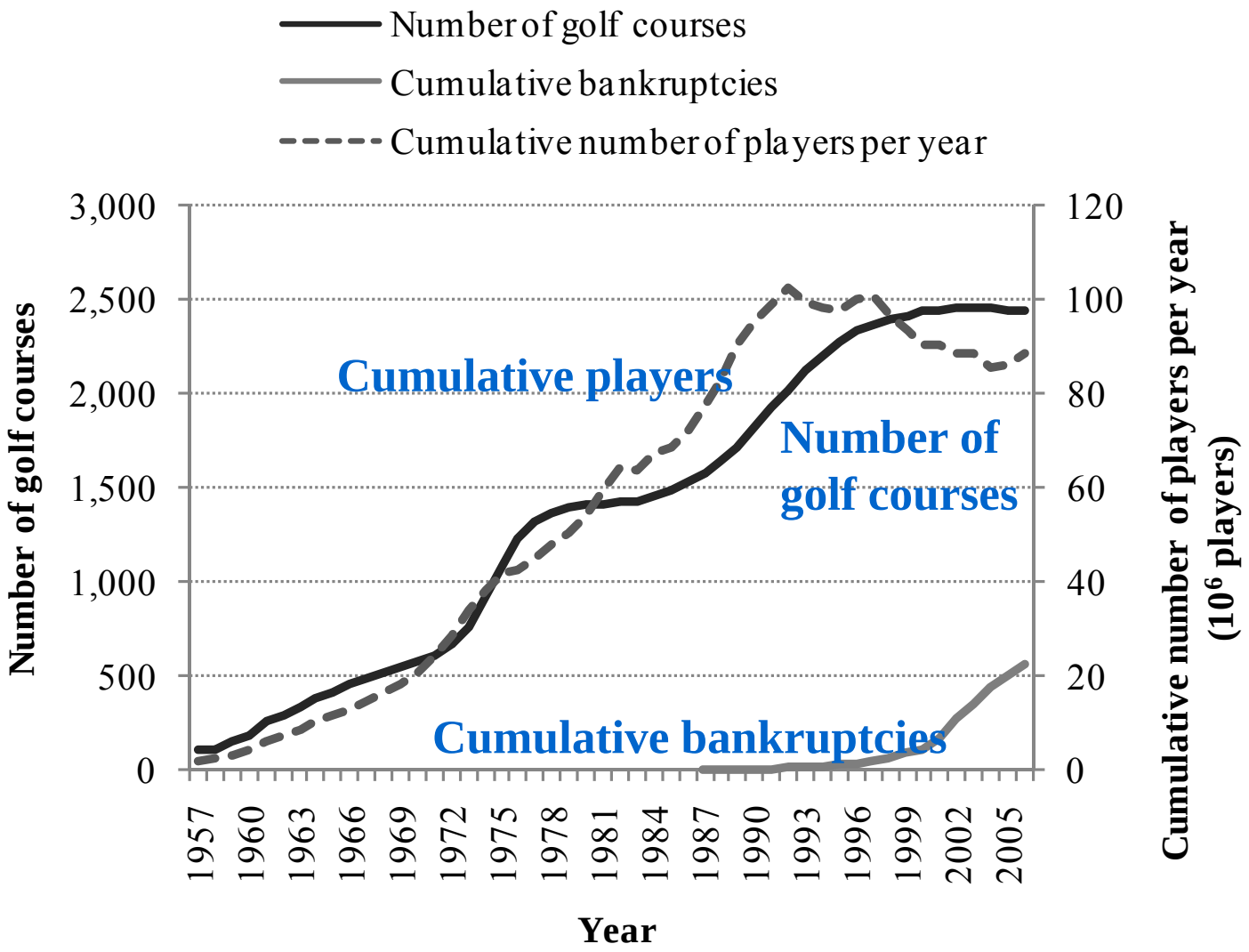
4. Sustainability of Resort Industry in Japan

(1) Resort development in the Tokyo Metropolitan Area

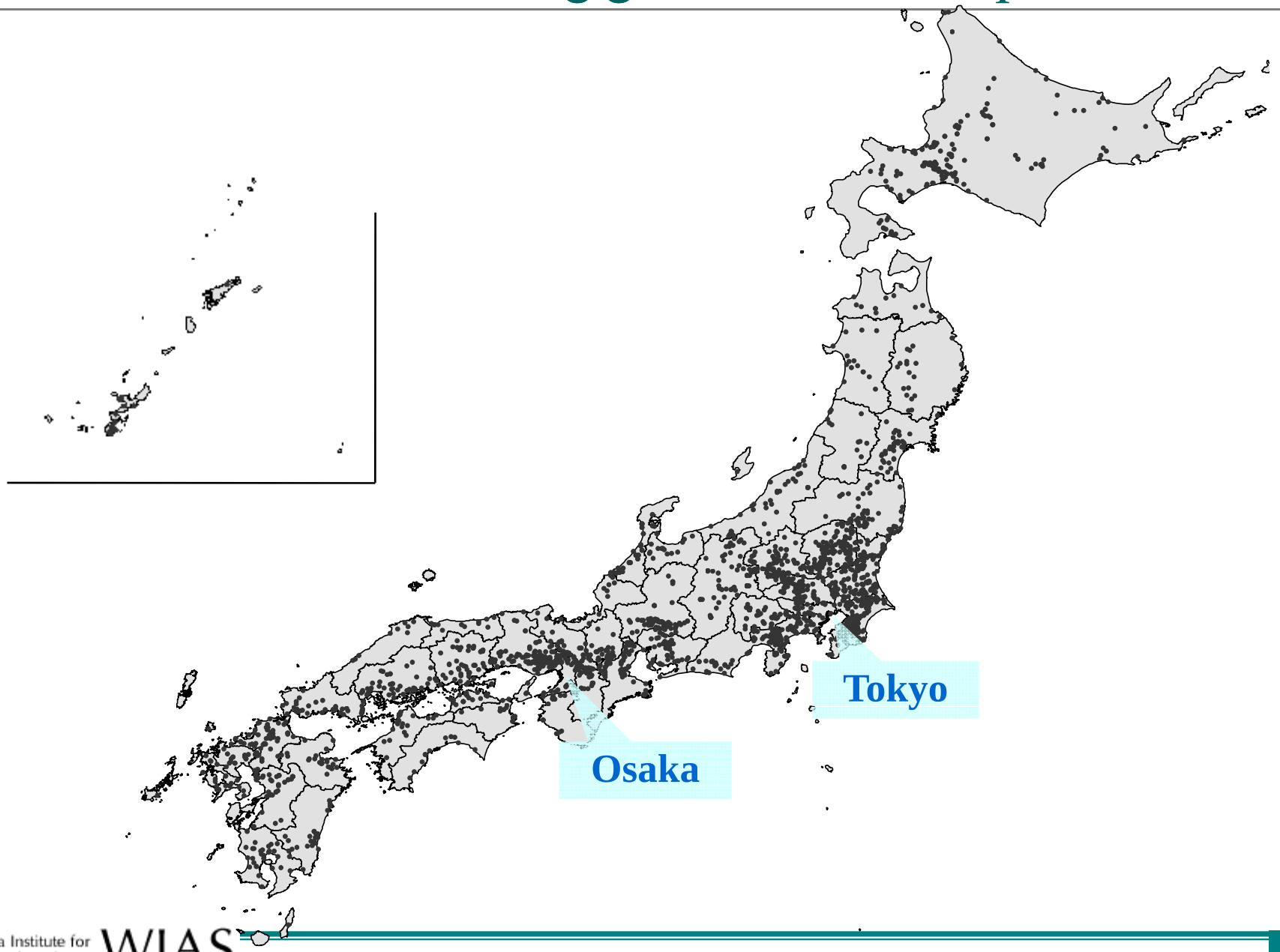
(2) Redundant golf courses

(3) Alternative Management Options for Restructuring Redundant Golf Courses

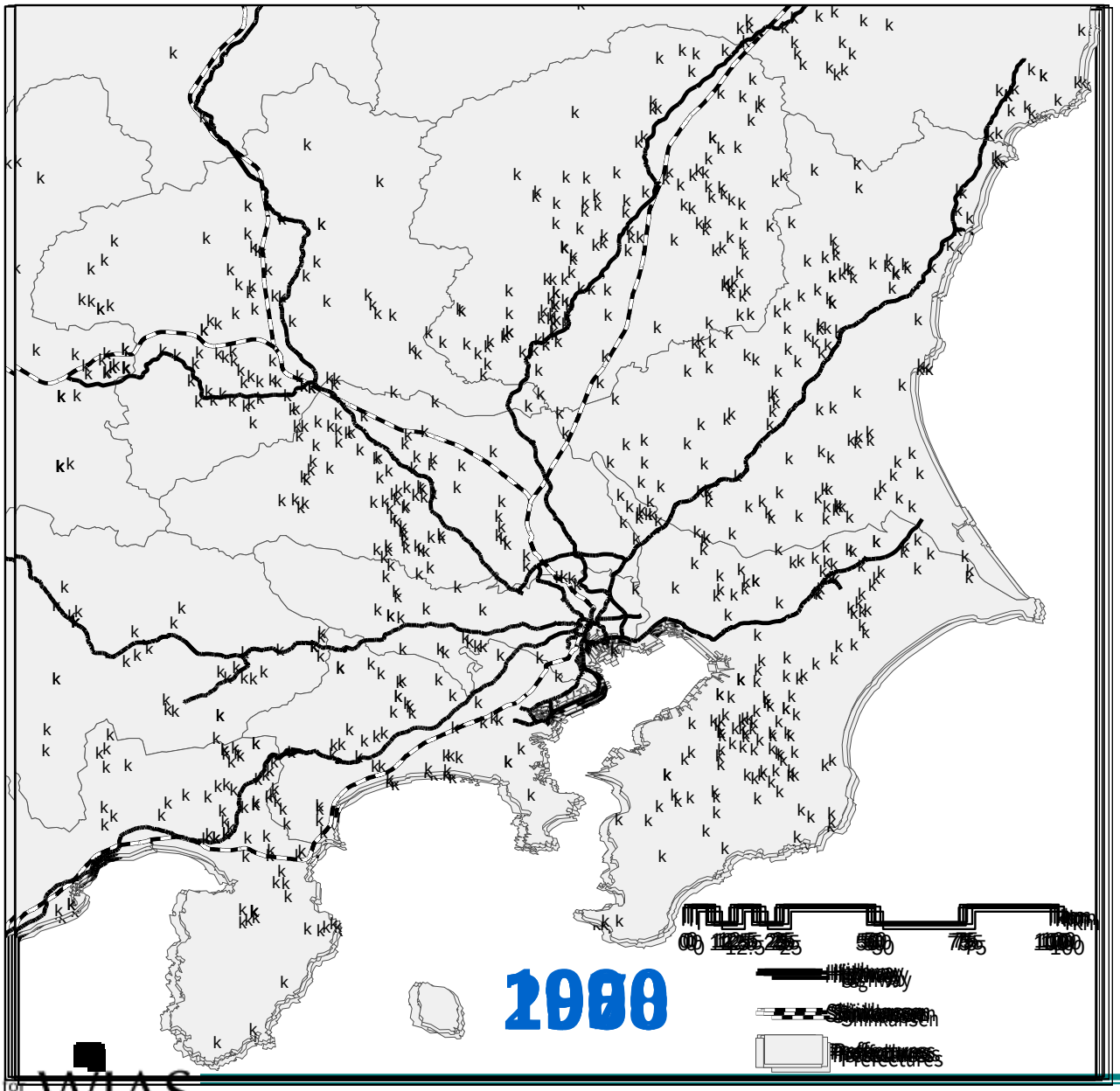
Development History of Golf Courses in Japan



Distribution of the existing golf courses in Japan

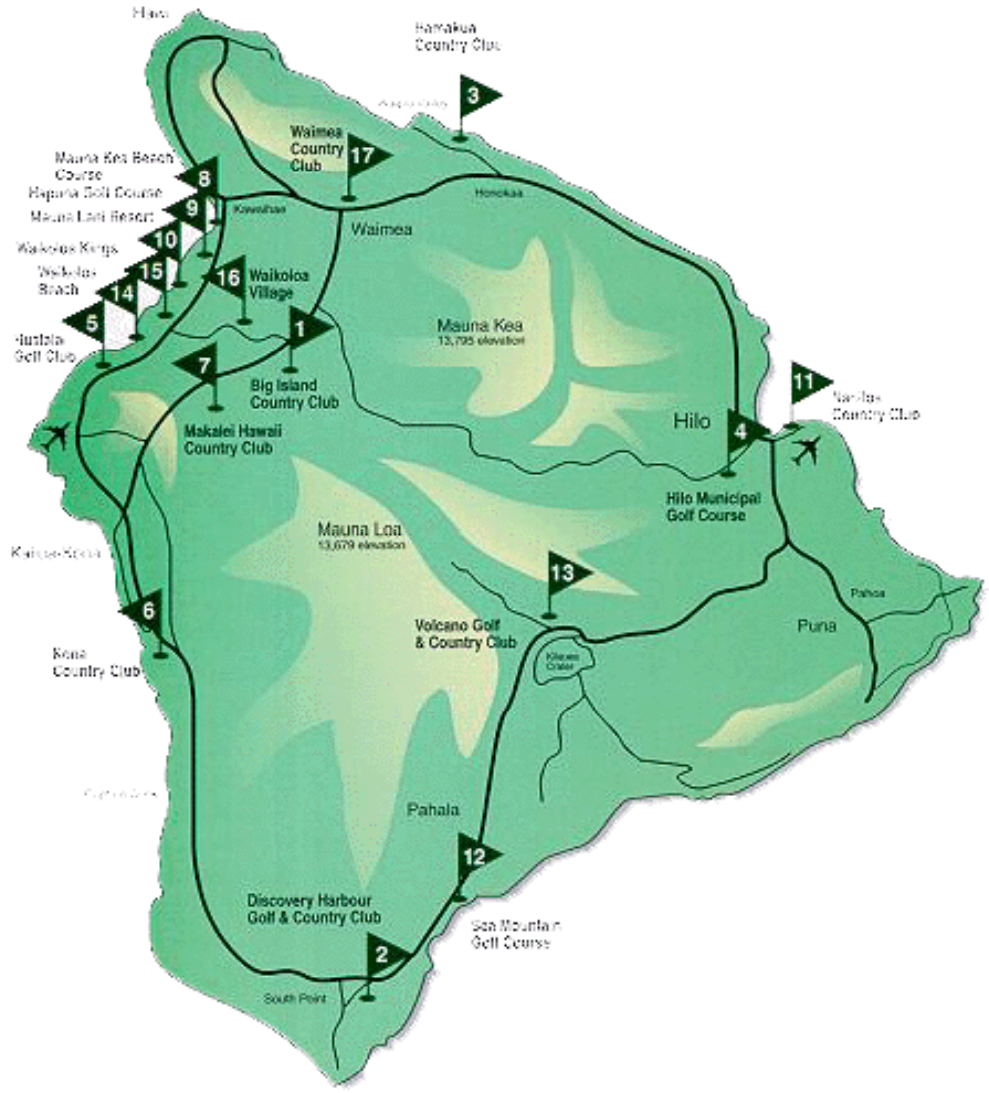


Expansion of golf course construction in the Tokyo MA



2008: Over 800 courses in Tokyo MA

Golf Courses in Hawaii Island



(Source) http://golflinkshawaii.com/golf/hawaii.html

1. Big Island Country Club
2. Discovery Harbor Golf & Country Club
3. Hamakua Country Club
4. Hilo Municipal
5. Hualalai Golf Club
6. Kona Country Club Ocean Course
7. Makalei Hawaii Country Club

[Mauna Kea Resort]

8. Mauna Kea Golf Course
9. Hapuna Golf Course
10. Mauna Lani Resort

North Course

South Course

11. Naniloa Country Club
12. Sea Mountain Golf Course
13. Volcano Golf & Country Club

[Waikoloa Beach Resort]

14. Waikoloa Beach Course
15. Waikoloa King Course
16. Waikoloa Village Golf Course
17. Waimea Country Club

(1) Redundant Golf Courses by 2035 in Japan

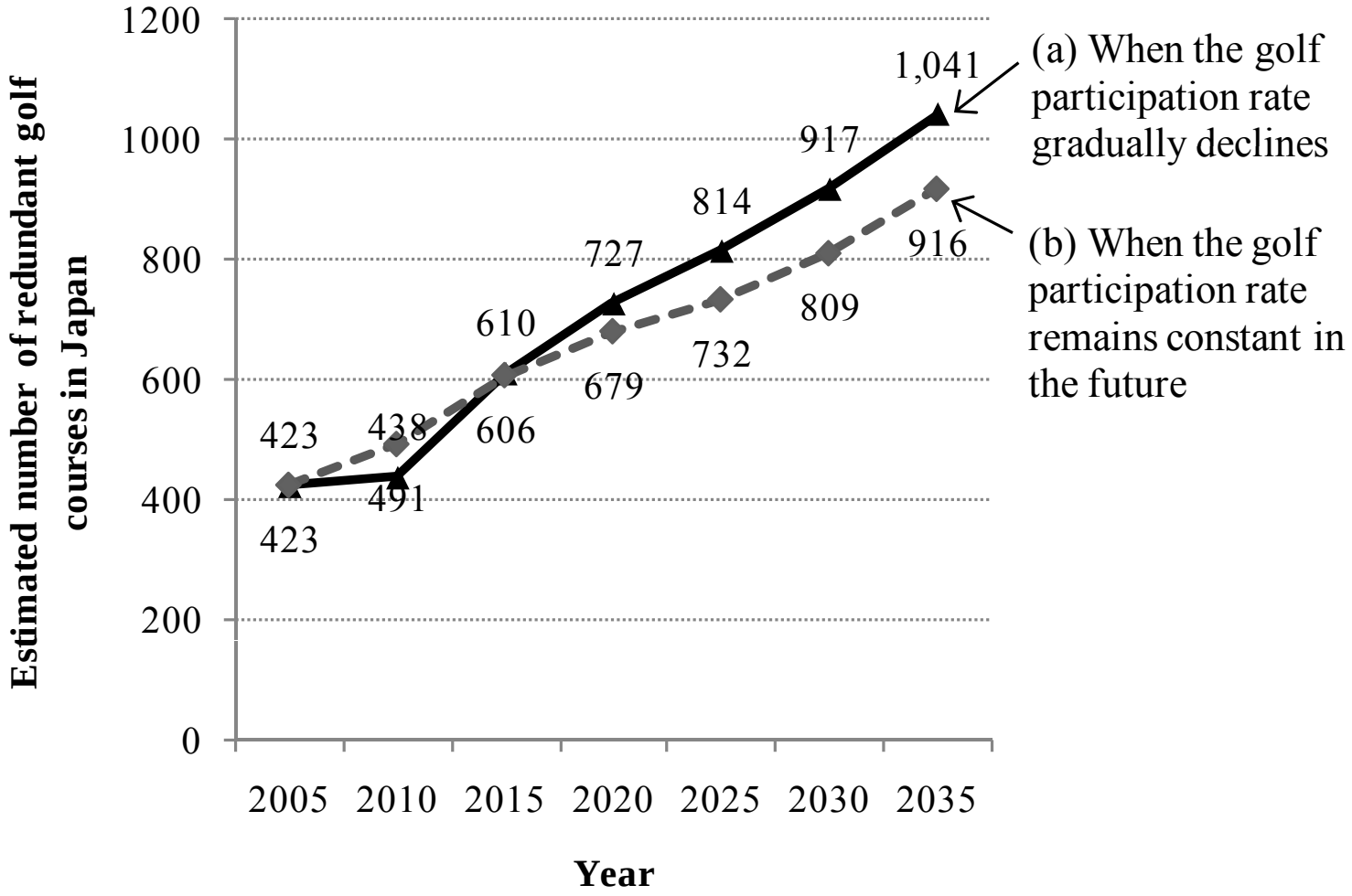
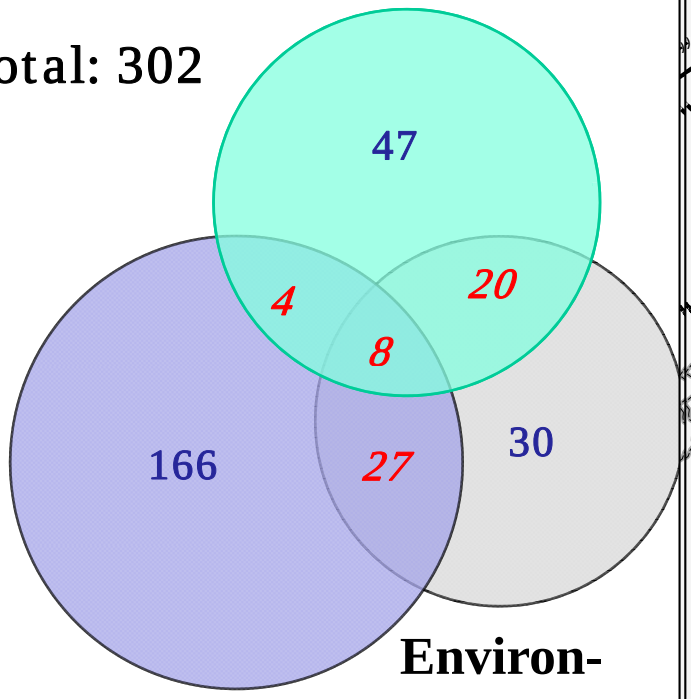
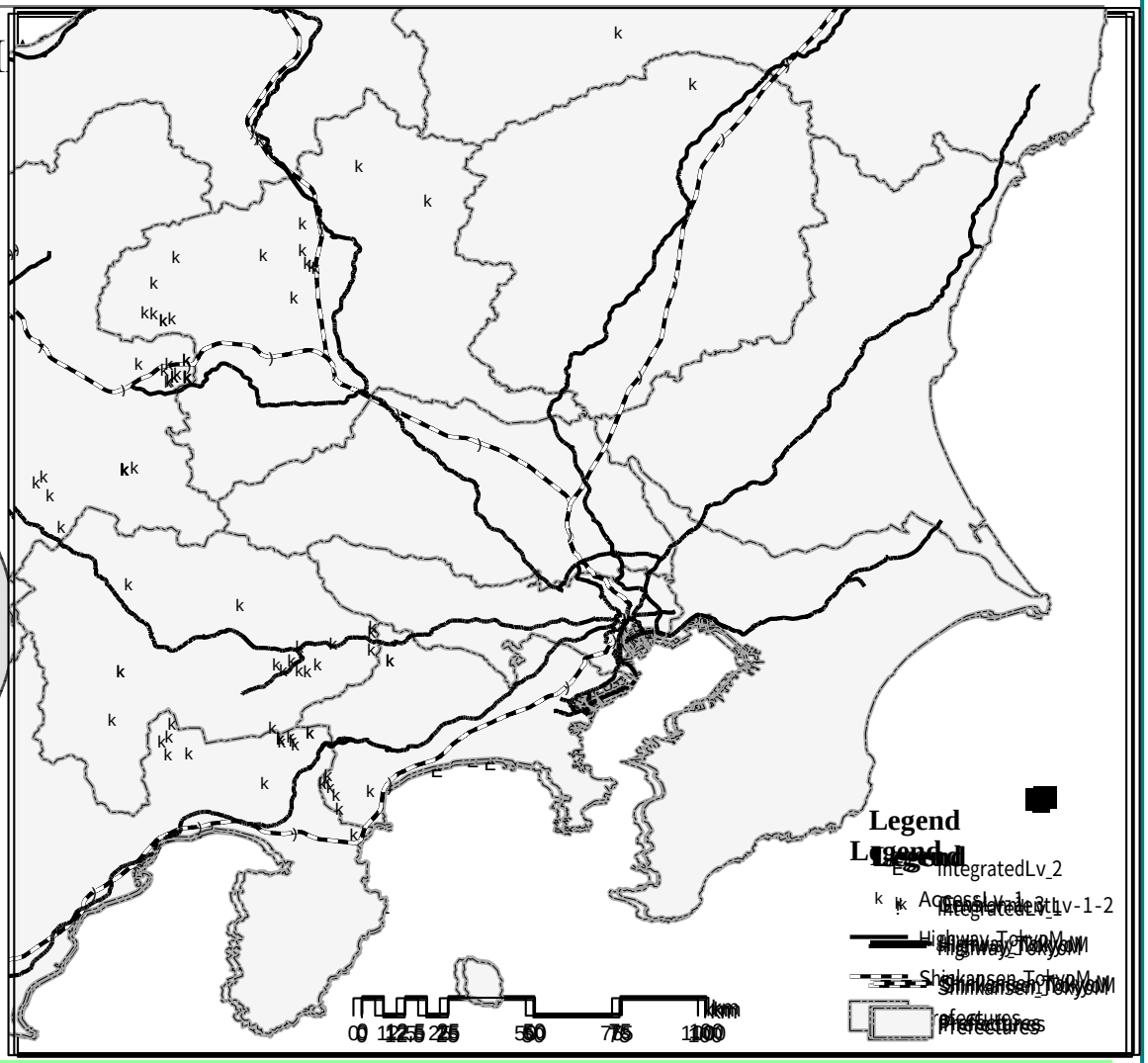


Figure 4 Estimation results of redundant golf courses in Japan

Spatial Distribution of Redundant Golf Courses

Out of over 800 courses in Tokyo M

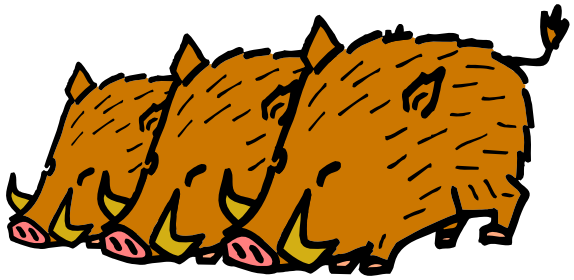




Integrated level 1: Overlapped parts (***bold italic figures***, **59 golf courses**) → ●

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)

The abandoned clubhouse

Landslide and erosion

(3) Alternative Management Options for Restructuring Redundant Golf Courses

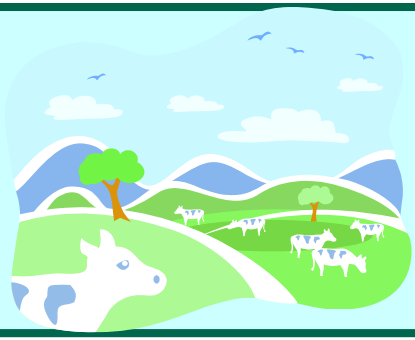
a) Multi-purpose space (park)

b) Cemetery

c) Biofuel feedstock plantation and storage site for biomass feedstock

d) Reforestation

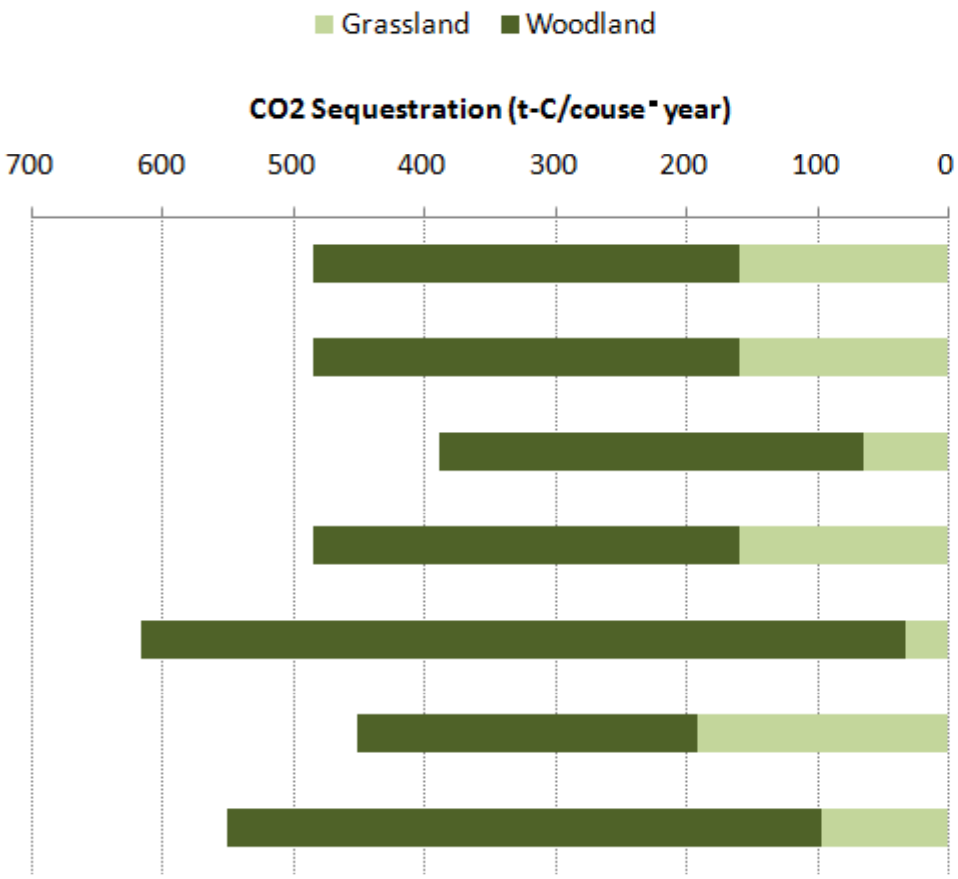
e) Pasturing

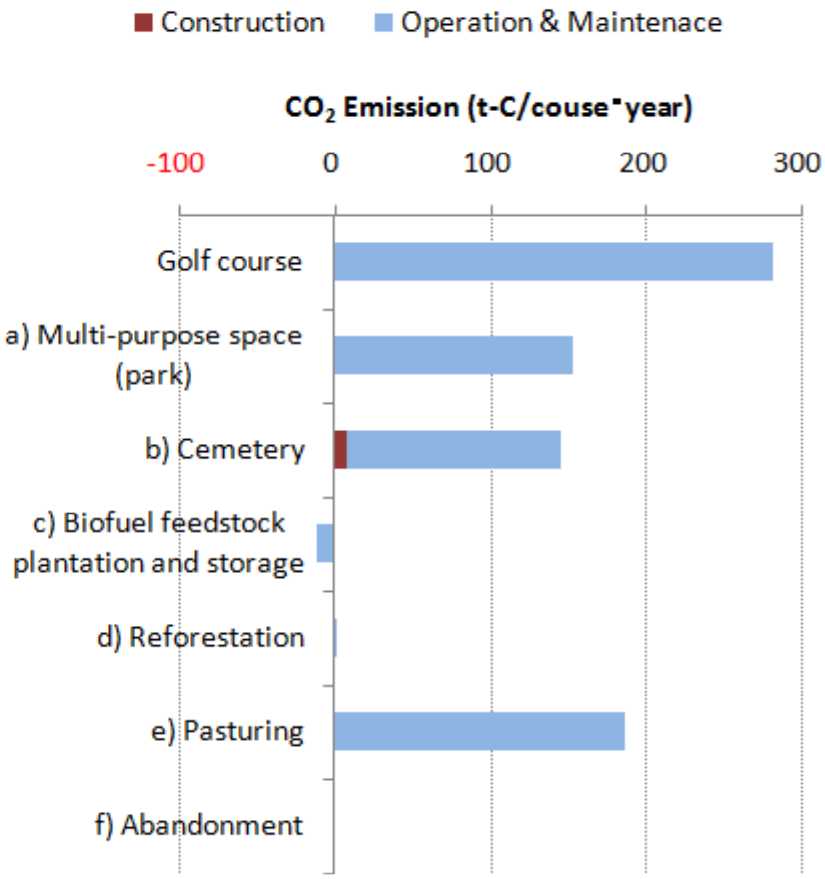


f) Abandonment

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

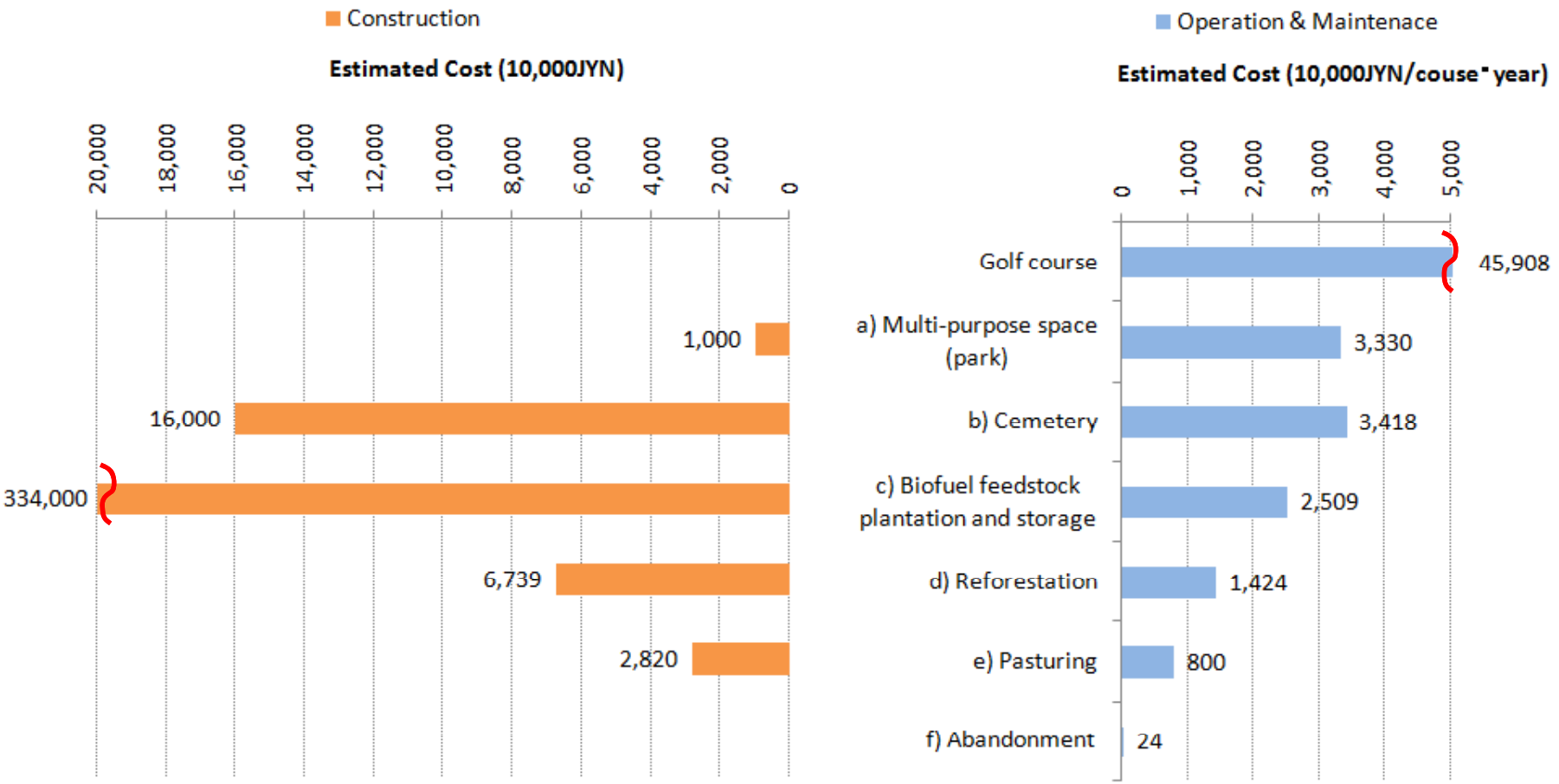
GHG Emission Estimation of Six Options





CO_2 Sequestration ⟵ **Per one course (100ha)** ⟶ **CO_2Emission**

Cost Analysis of Six Options



Construction cost (Initial cost) ⟵ **Per one course (100ha)** ⟶ **Operation cost**

Scenario Analysis

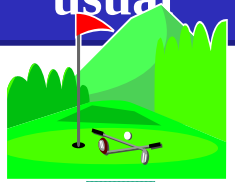
Redundant Golf Courses in Tokyo MA (152courses)

Maintain as golf courses

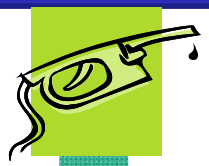
Six options

A B C D E F

Business as usual



Generating Energy



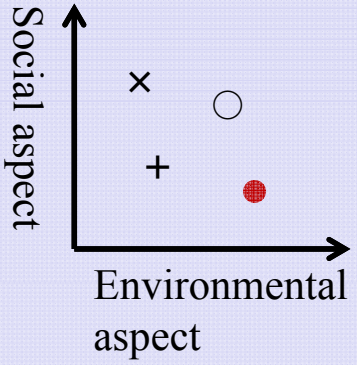
Amenity and Comfort

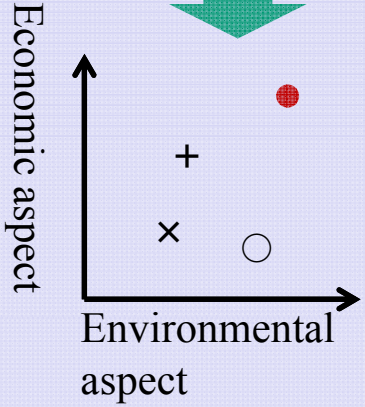
Nature Restoration

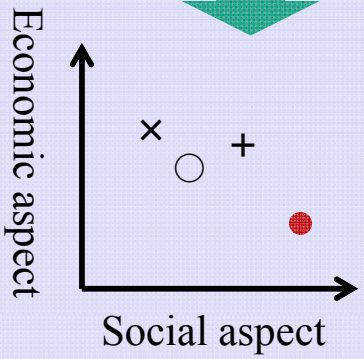
Environmental

Social

Economic

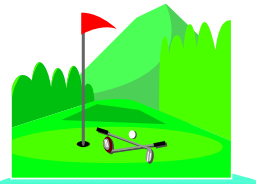






Four scenarios

Environmental Mitigation
by Technology



Business as usual

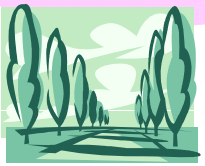
Generating Energy

Shrink and retreat

Vitalization of rural economy and community

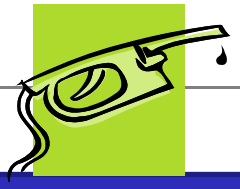
Nature Restoration

Amenity & Comfort



Conservation of nature and ecosystem/Cultural heritage

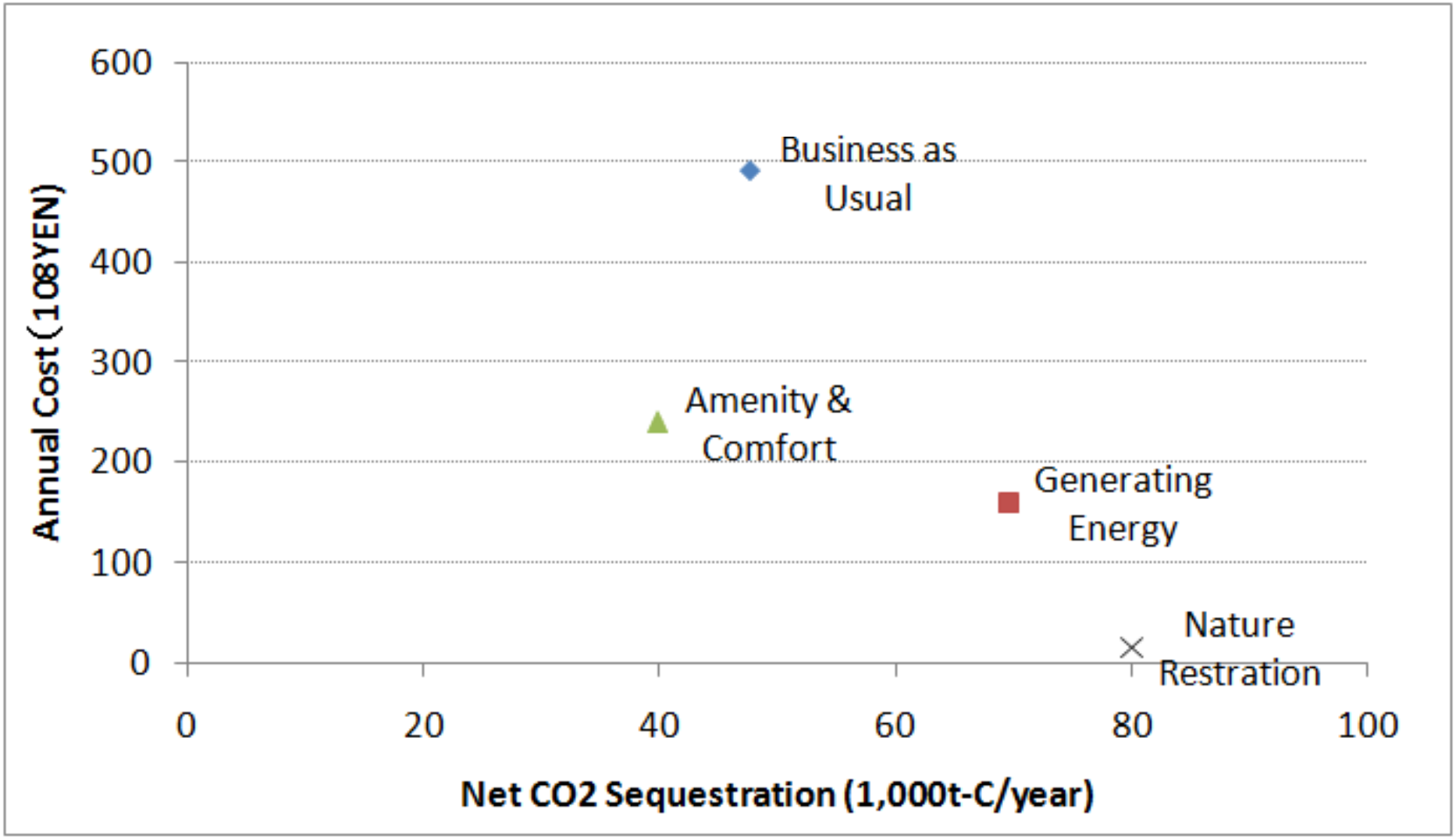
Restructuring scenarios

	Business as Usual	Generating Energy	Amenity & Comfort	Nature restration
Golf courses	■		■	
(a)Multi-purpose space (park)		■	■	
(b)Cemetery			■	
(c)Biofuel		■		
(d)Reforestation	■	■		■
(e)Pasturing		■	■	■
(f)Abandoment	■			■

(The darker options are, the more applied to the scenario)

Result of the scenario analysis



Summary of redundant golf courses in Japan

- 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.
  - attempted environmental and economic assessment of six management options

Acknowledgement:

This study was carried out as part of the Tenure Track Program at Waseda Institute for Advanced Study, which is supported by the program entitled “Promotion of Environmental Improvement for Independence of Young Researchers” under the Special Coordination Funds for Promoting Science and Technology provided by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan.

Relevant journal papers and presentations:

- Dang Thanh Tu, Osamu Saito, Akihiro Tokai and Tohru Morioka (2009) Biomass Potential and Material Flow in the Mekong Delta of Vietnam, Environmental Systems Research, 37 (submitted).
- Osamu Saito (2008) 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, 3rd International Conference on Sustainability Engineering and Science (December 9-12, 2008).
- Kazunori Shimada,Toshio Katsuki, Kojiro Iwamoto and Osamu Saito (2008) Management effects on the community structure and species richness of secondary Quercus serrata -Q.acutissima woodland in the southwest Tama area,Tokyo, Japan, Vegetation Science, 25: 1-12.
- Shoko Kajimoto, Osamu Saito, Kazunori Tanji, Tohru Morioka (2006) Rural Future Scenario Analysis based on a Sound Urban-rural relationship at a River Basin Scale, Environmental Systems Research, 34: 545-551.
- Emma Abasolo, Kazunori Tanji, Osamu Saito, Takanori Matsui and Tohru Morioka (2006) Measuring Contribution of Ecosystem Services to Urban Quality of Life, Environmental Systems Research, 34: 599-609.