Proceedings of the First International Symposium by Osaka University Research Institute for Sustainability Science (RISS)
"Strategies to Achieve a Sustainable Closed-loop Economy in Asia"

November 22, 2006
Hankyu Sanwa Conference Hall, Icho Kaikan, Osaka University

大阪大学サステイナビリティ・サイエンス研究機構（RISS）
第１回国際シンポジウム『アジア循環型社会の形成』

2006 年 11 月 22 日
大阪大学銀杏会館３階 阪急電鉄・三和銀行ホール

Organized by
Osaka University Research Institute for Sustainability Science (RISS)

Co-organized by
Integrated Research System for Sustainability Science (IR3S)
Hokkaido University Sustainability Governance Project (SGP)
Global Environment Forum-KANSAI

Supported by
Osaka Prefectural Government
Kansai Economic Federation

主催：文部科学省科学技術振興調整費　（戦略的研究拠点育成）プロジェクト
大阪大学サステイナビリティ・サイエンス研究機構
共催：サステイナビリティ学連携研究機構（IR3S）
北海道大学サステイナビリティ・ガバナンスプロジェクト（SGP）
地球環境関西フォーラム
後援：大阪府
社団法人 関西経済連合会

文部科学省科学技術振興調整費（戦略的研究拠点育成）プロジェクト
Supported by Special Coordination Funds for Promoting Science and Technology of the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan

PROGRAM

Human, Society, Global Environment
Research Institute for Sustainability Science
大阪大学
サステイナビリティ・サイエンス研究機構
Osaka University Research Institute for Sustainability Science

First International Symposium on "Strategies to Achieve a Sustainable Closed-loop Economy in Asia"

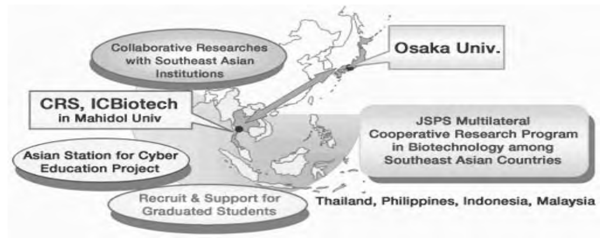
RISS Executive Director TOYODA Masao

November 22, 2006
Ichio-kaikan, Osaka University

 1

Osaka Univ. Motto "live locally, grow globally"

- The world research network of Osaka Univ.
  - Agreements with 44 universities, and with 186 bureaus
  - 3 educational research centers abroad, operated as organizations supported by the whole university :
    San Francisco(U.S.A.)、Groningen(Netherlands)、Bangkok(Thailand)
  - Cooperative Research Station in Southeast Asia, launched out by the International center of Biotechnology



  - Environmental science technical study with Vietnam, supported by "Japan Society for the Promotion of Science"
  - International educational program about green material chemistry for Vietnam

 2

IR3S

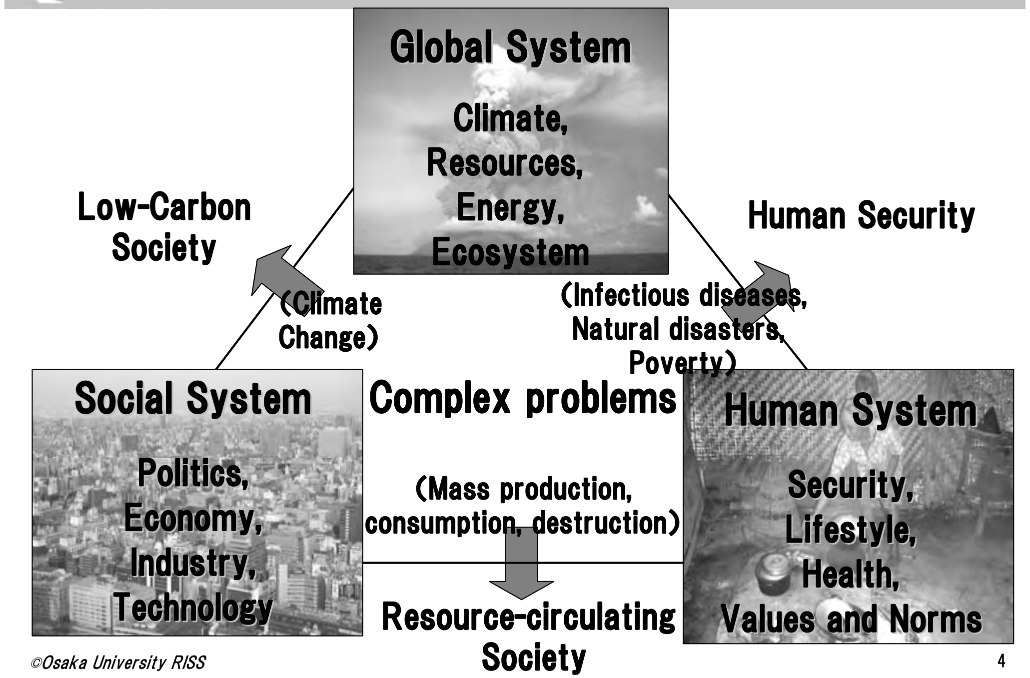
- IR3S
  (Integrated Research System for Sustainability Science)
  - Joint research by a close alliance of universities and institutes

Five participating Universities	Four cooperating institutions
•TIGS (University of Tokyo)	•Toyo University
•KSI (Kyoto University)	•NIES
•RISS (Osaka University)	•Tohoku University
•SGP (Hokkaido University)	•Chiba University
•ICAS (Ibaraki University)	

- Sustainability Science
  - Rebuilding and repairing global, social and human systems

 3

Rebuilding and repairing three systems



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RISS Organization

External Evaluation Committee

Osaka University
RISS (Research Institute for Sustainability Science)
Executive Director: Masao Toyoda

RISS Steering Committee：H.Miyahara (President), U.Umakoshi (Vice President), M.Toyoda (Dean of Engineering graduate school), Deans of other graduate schools

Project Management Office (Director: Tohru Morioka)

Design House
Scenario Unit
Strategy Unit

Sustainability Science and Technology Development Laboratories
A
B
C

IR3S participating universities and cooperating institutions

Flagship Project

Advisory Board, Alliance Industries

Mission of RISS

Global
Society
Human

①What are problems?
The current global sustainability crisis has much to do with the breakdown of the three systems and their linkages.

③Practices
①Education
②Research for sustainability
③Practice (Local &Global)

②How to solve?

Future Scenarios & Strategic Management of Technology Development

Technology Development
Social System Design

Designing a Sustainable Society

Design a sustainable closed-loop economy with eco-industrial technology

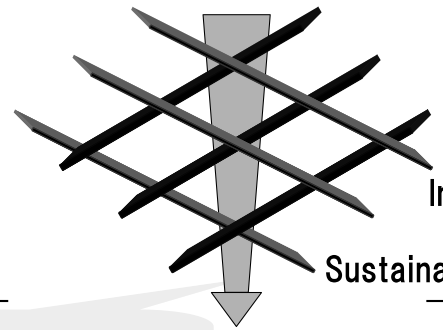
①Design visions and strategies to achieve a society that minimizes the environmental burden through the circulation of resources.
②Design urban and regional systems that prioritize the use of eco-technology and industrial ecology.
③Design low-impact and high-efficiency production technology.
④Design institutional changes of building a sustainable society.
⑤Design institutional systems of promoting environmental technology developments.
⑥Design sustainable communication.

Establish management models of Industry, Technology, and Society

Trials of training and educational programs for young researchers and graduate school students, and its continuation

Technology Development and Social System Design

Technology Development
Eco-energy
Eco-process
Eco-design

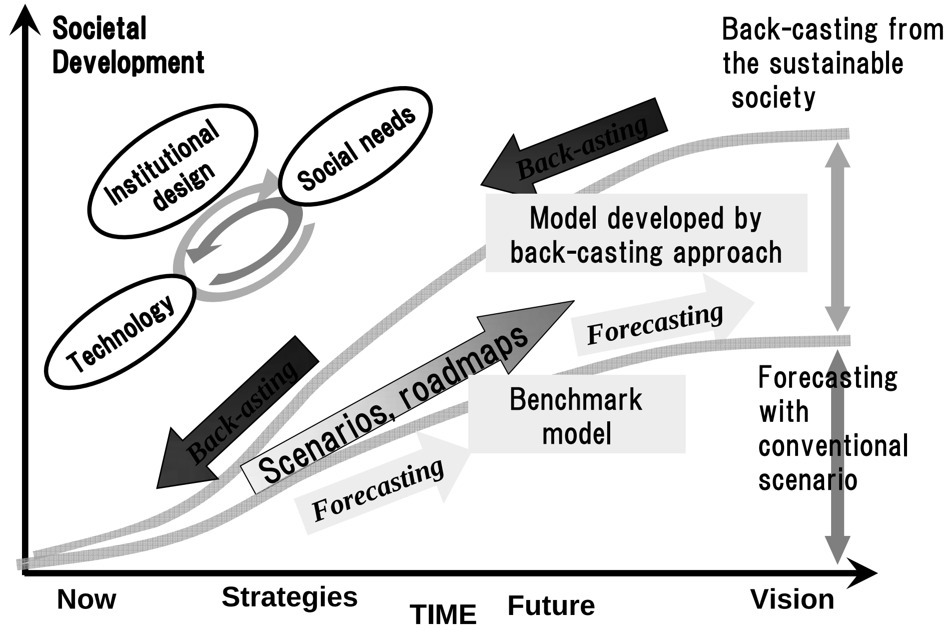


Social System Design
Future Scenarios
Institutional Design
Sustainability Assessment

Wisdom for harmony with nature, continuity, and mutual dependency

Achieving a Sustainable Closed-loop Economy
(Including Resource Circulating, Eco-technology, Industrial Ecology, and Technology Integration)

Scenario Design with Back-casting



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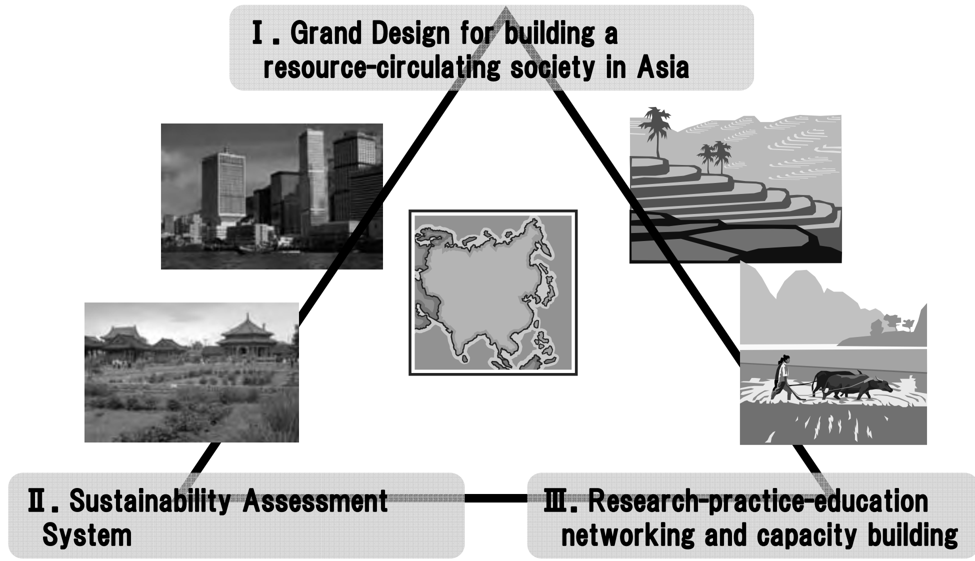
Flagship project: Building a resource-circulating society in Asia

Project leader: Osaka Univ., Co-leader: Hokkaido Univ.



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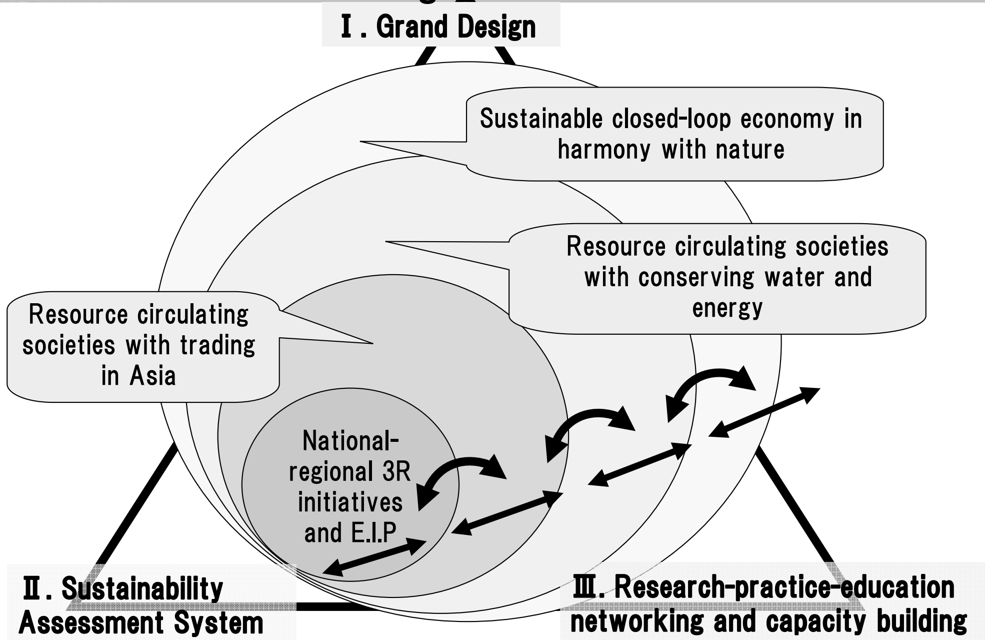
Approach for building resource circulating societies in Asia



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Networks of research & education for sustainability science

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Sustainability Science Educational Program

Professionals capable of working in the international arena to build a sustainable society

- Grasp diverse, global, and trans-disciplinary nature
- Work in practical societal contexts

Minor course of masters degree

Sustainability Science basic modules
Practical course based on RISS research issues (in English)

Sustainability Science specific modules
Courses selected from view of Sustainability Science (in English)

Sustainability Associate modules
Courses provided by graduate schools

Masters program of IR3S

Intensive short-term program for practices in the International scientific community

The Univ. of Tokyo, Kyoto Univ., Hokkaido Univ., Ibaraki Univ.

Cooperating with universities in Asia and the Pacific

Events organized by RISS

- Symposium on "Establishing Recycling-oriented Society for Sustainable Asian Cities"
  - 2006, November 4 at Vietnam National University Hanoi city
- Workshop on "Sustainable Society and Industry Transformation with Zero Emission Initiatives"
  - 2006, November 6,7 at Vietnam National University Ho-Chi-Minh city
- RISS first International Symposium "**Strategies to Achieve a Sustainable Closed-loop Economy in Asia**"
  - 2006, November 22 at Osaka University Icho-kaikan
- Sustainability Education International Workshop
  - 2007, February 13～14 at Osaka University Nakanoshima Center's Saji Keizo Memorial Hall

Opening Message

Masao Toyoda, Ph.D.
Professor, Executive Director, Research Institute for Sustainability Science, Osaka University

Profile

Name Masao Toyoda, Ph.D.

Affiliation Executive Director, Research Institute for Sustainability Science
Dean of Graduate School of Engineering
Professor of Department of Material and Manufacturing Science,
Graduate School of Engineering, Osaka University

Education:

1967	Bachelor's degree from Osaka University, Department of Welding Eng.
1979	Master's degree from Osaka University, Department of Welding Eng.
1973	Doctor of Engineering from Osaka University

Professional Career:

1969-1974	Research Assoc., Dept. of Welding Eng., Fac. of Eng., Osaka Univ.
1974-1989	Associate. Prof., Dept. of Welding Eng., Fac. of Eng., Osaka Univ.
1989-1998	Prof., Dept. of Welding & Production Eng., Osaka University
1998-Present	Prof., Dept. of Manufacturing Science, Osaka University
2004-Present	Dean of Graduate School of Engineering and Faculty of Engineering, Osaka University

Membership in Academic Societies:

Japan Welding Society, American Welding Society, ASME, JSME, JISI, Architectural Institute of Japan, Society of Naval Architecture of Japan, High Pressure Institute Japan, etc.

Main official of Society:

President (past) and Vice President (former) of Japan Welding Society, Director of Japan Welding Society, Vice president and Director of Japan Institute of Welding, Chairman of Welding Mechanics Committee of JWS, Chairman of Technical Committee of Steel Div. of JWES, Member of Editorial Committee of Journal of JWS & JWES. etc.

Research Fields/ Interests:

Welding mechanics ,Strength of welded structures, Fracture mechanics, Interface mechanics

Publications:

[Books]

・ Welding Engineering, Rikogakusha, Rikogakusha (1979).
・ Handbook of Strength of Welded Joints, Rikogakusha (1988).
・ Interface Mechanics, Rikogakusha (1991).
・ Mystery and Emotion : Technology for splendid artifacts, STRUCT (1998)
And more 5 books

[Papers (Total publications)]

・ Papers with referee: 232
・ Papers of proceedings of int. conf.: 174
・ Technical articles: 79

Switch the Eco-complexity of Production-Consumption into Sustainability of Efficiency-Harmony

Rusong Wang, Ph.D.
Professor, Research Center for Eco-Environmental Sciences,
Chinese Academy of Sciences

Abstract

Human production-consumption system is not an isolated system but a Social- Economic- Natural Complex Ecosystem, driven by energy, capital, power and spirit, & maintained by ecological cybernetics of competition, co-evolution, circulation and self- organization. Its natural pool consists of the Chinese traditional Five Elements: metal (minerals), wood (living organism), water (resource and environment), fire (energy and atmosphere) and soil (soil and land). Its production and consumption connect with transportation, reduction and regulation. While its social agents are technology, institution & culture. Its ecological sustainability can only be assured with a human ecological understanding of the complex interactions among environmental, economic, political, and social/cultural factors & with careful planning and management grounded in ecological principles in the context of time, space, process, structure and function (Fig.1).

Ecological integrity was well developed in ancient China, which is grounded in human ecological principles such as that of Yin and Yang, Wuxing, Zhong Yong and Feng-Shui. However, during the past two decades, most Chinese enterprises have given up the tradition. Currently, there is a campaign of circular economy in China from both ways of top-down and bottom up according to following principles for eco-industry planning and management such as the city of Yangzhou, Rizhao and Dafeng.

Food web-based horizontal/parallel coupling: connecting the different production processes and to gain positive benefit from the negative environmental impacts through sharing unused resources.

Life cycle-oriented vertical/serial coupling: combining primary, secondary and tertiary industries, consumption and recycling sectors into one eco-industrial complex along the life cycle to let the production more systematically responsible.

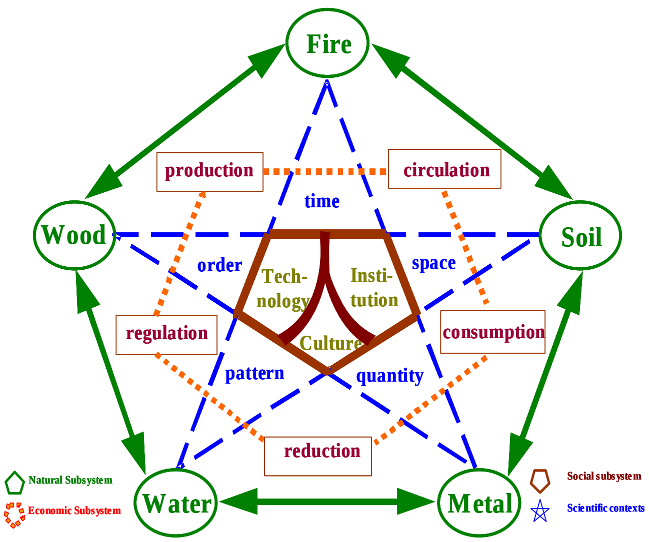


Fig.1 Close the loop: Social-Economic-Natural Complex Ecosystem

Ecosystem-based regional coupling: integrating of regional environment, local community, dominant enterprises and other diversified sectors into one agro-industrial-service eco-complexity to internalize environmental costs and pollutants could be assimilated and minimized within the system itself.

Flexible and adaptive structure: multiple production function, diversified products & easy- to-change process rather than rigid, unified & imitation one to adapt to the external change.

Functional service rather than products output oriented production: switching the production focus from products to service with three kinds of final outputs: goods, services and culture; switching the mono-goal of production from profits to three dimensional niches of wealth, health & faith.

Capacity building: Enhancing the capacity of service & training; research & development; incubation & consultation; adaptive and comprehensive decision making, sensitive information feedback, effective networking of knowledge, experiences and experts, and eco-integrated decision making.

Employment enhancement: increasing rather than decreasing working opportunity through creating more job in Research and Development, Service and Training within the industrial ecosystem, though the processing work place might be reduced due to the automation.

Respecting human dignity: working is a learning and innovation process, a social interactive and self-enjoyment engagement, rather than slaved by machine and oriented mainly to earn one's salt. Human ecological gains at moral, believing are much more important than that of material life along.

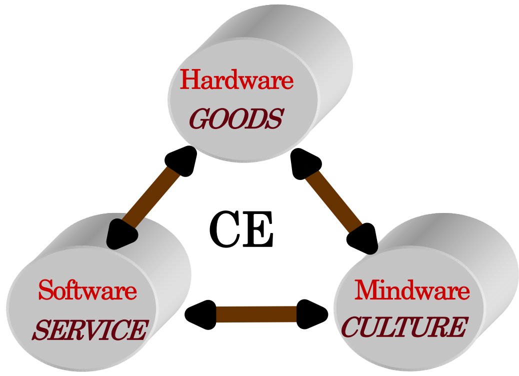


Fig.2 3 Goals of Circular Economy

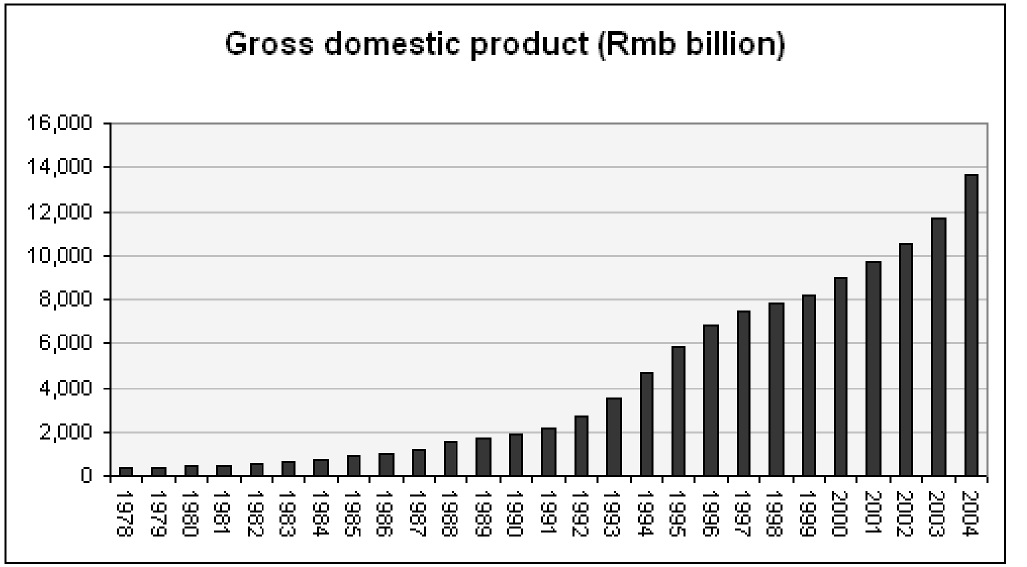
Rethinking, Reform & Renovation

-- Switch complexity into sustainability

Rusong WANG
RCEES, Chinese Academy of Sciences

Contents

I. China : Development stress & environment threats



China in Change

Rapid growth,
High density,
Large scale,
Less cultural & ecological identity
Significant social & econ. progress
Significant env.& ecological impacts

- Heavy industry
- Large scale infrastructure
- Car-driven manufacture
- Real estate business

High pressure of urbanization in China

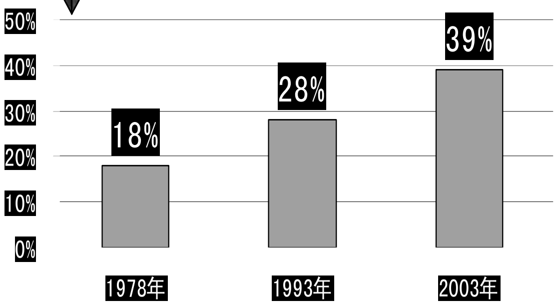
Population

Development

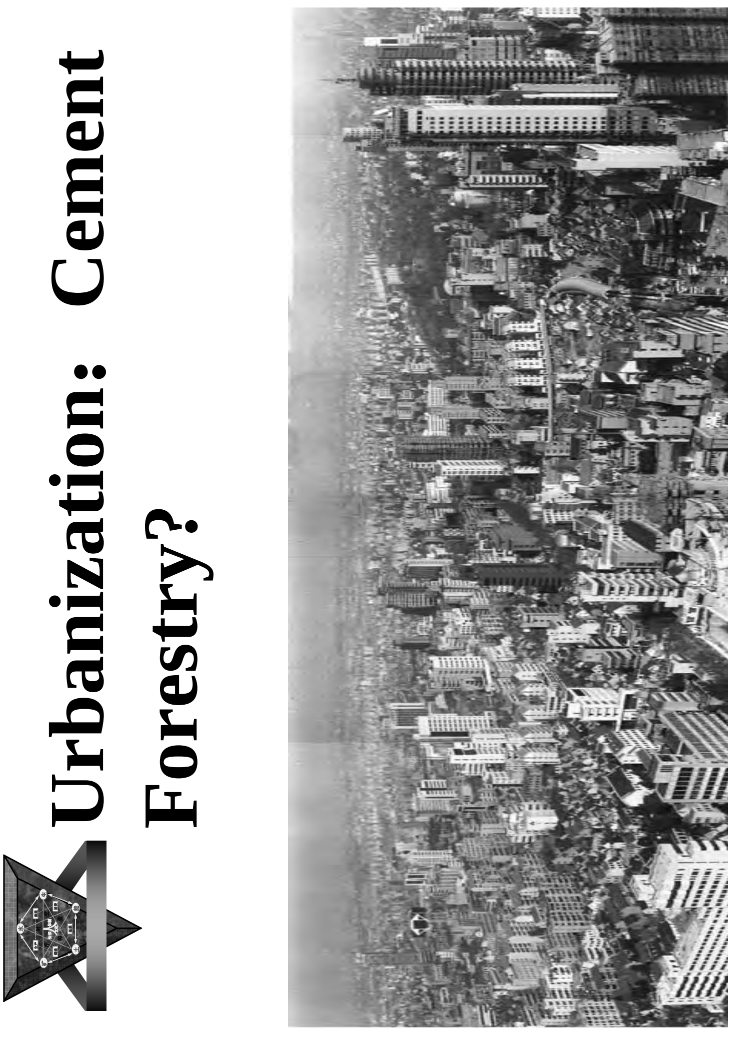
Environment

Infrastructure

Fast Urbanization

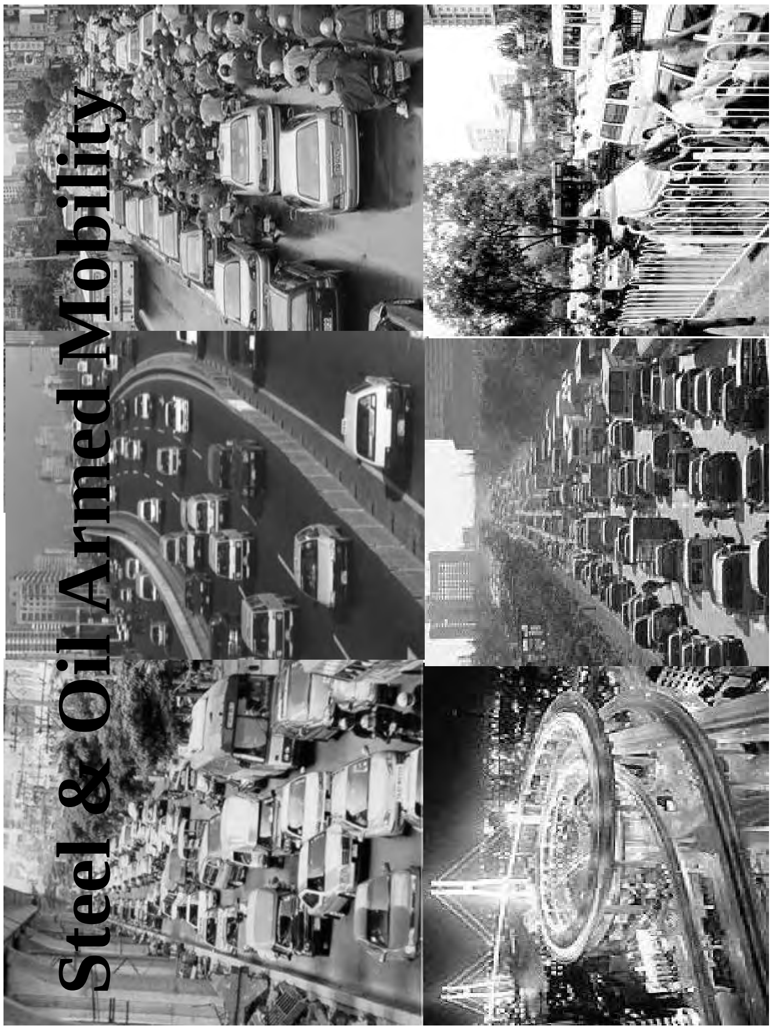


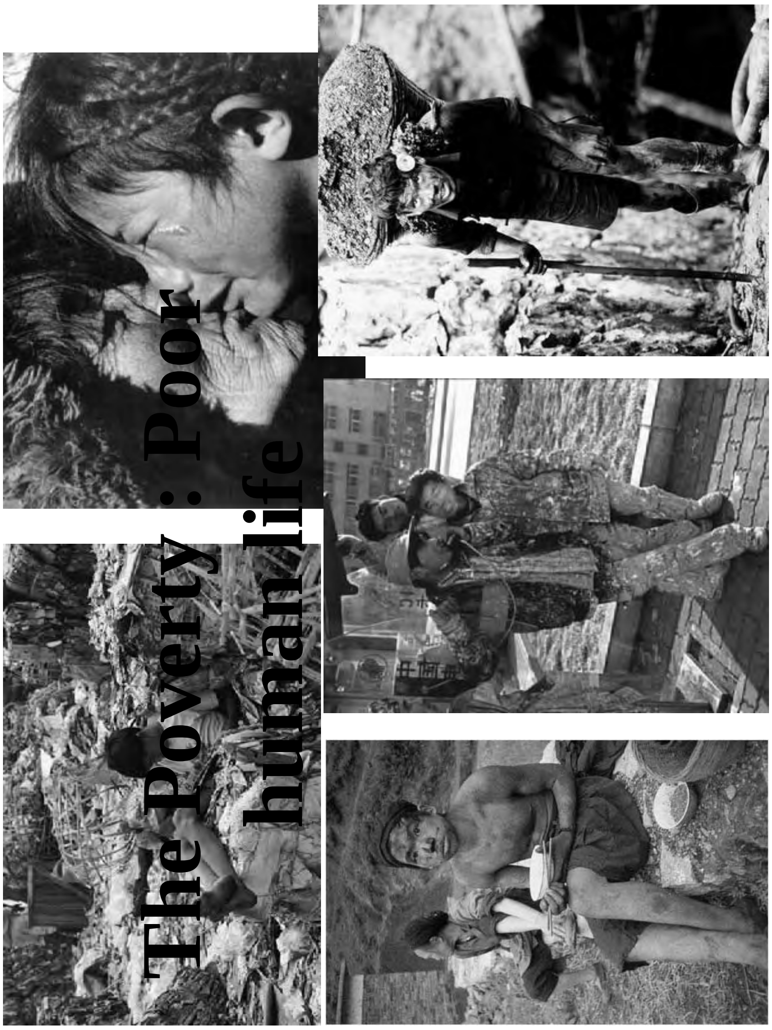
2003:
City: 660, Township; 20601
Urban population: 520 Million
Area: 399,000 km^2
Built up area: 28,000 km^2

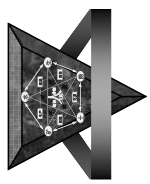

Urbanization: Cement Forestry?


Real Estate Business

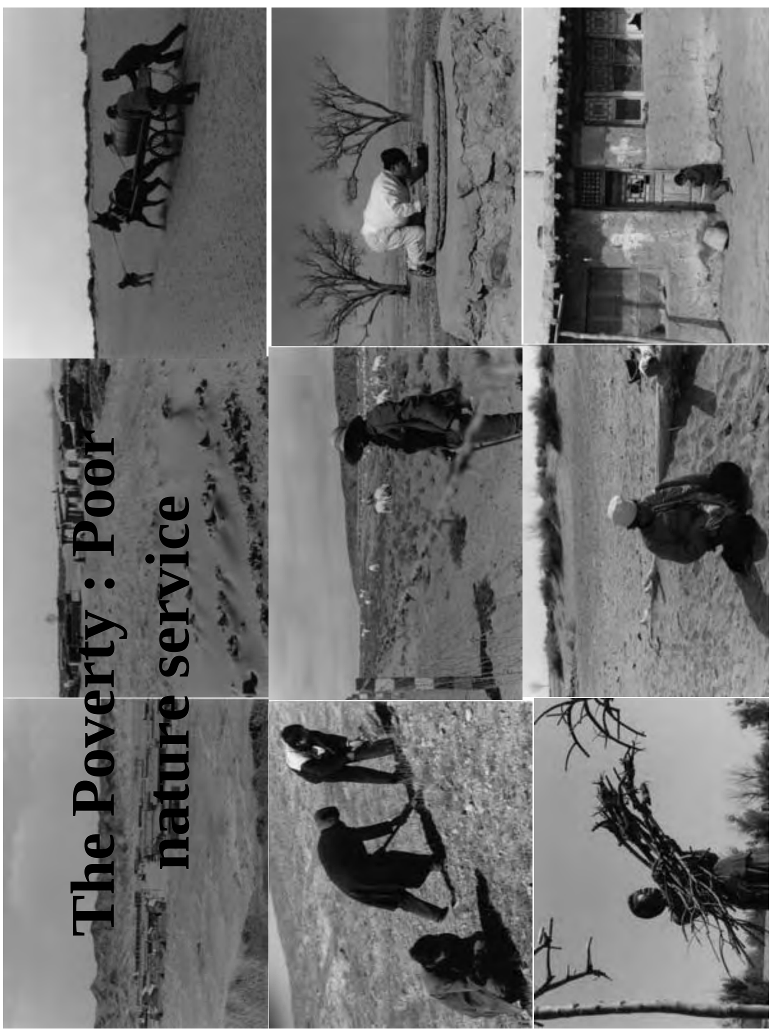

Bicycle and tricycle Kingdom


Steel & Oil Armed Mobility



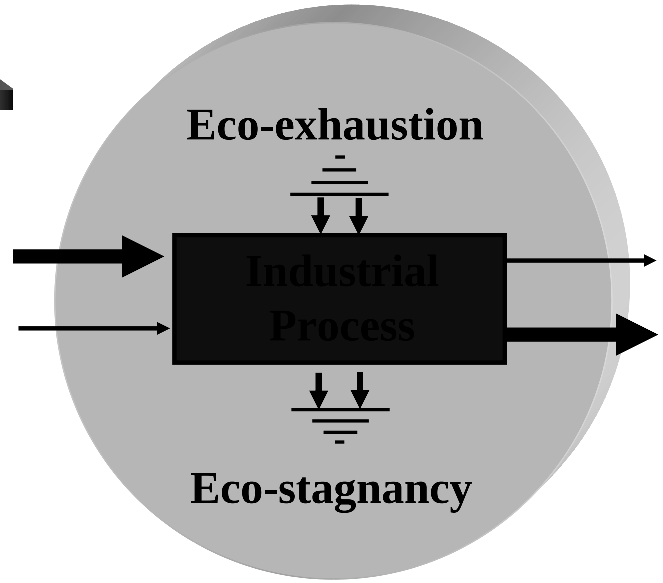


II. Rethinking the social-economic-natural eco-complex



❖环境问题的生态学实质
The eco-essence of sustainability issue

- ❖资源代谢在时间、空间尺度上的滞留和耗竭
- ❖Stagnancy and Exhaustion of Resource Input-Output
- ❖系统耦合在结构、功能关系上的破碎和板结
- ❖Fragmentation and Agglomeration in System Structure and Function
- ❖社会行为在局部和整体关系上的短见和调控机制上的缺损
- ❖Short-sighted & mechanism lacking in dealing with the relationship between parts & whole



The Material Flows of Industrial Ecosystem

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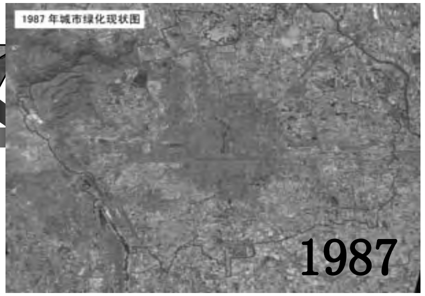
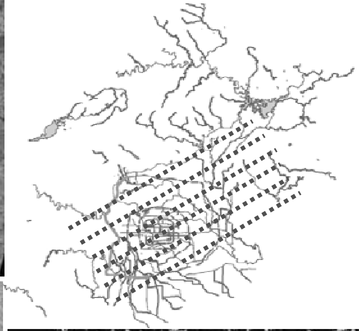
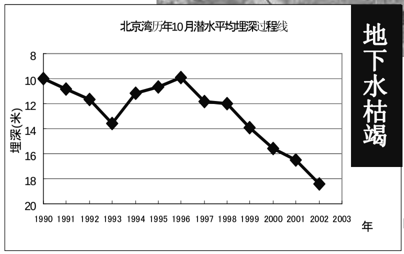
结构破碎





河川断流

景观破碎



地下水枯竭

Structure Fragmentation

Landscape Agglomenration & Soil hardening

系统板结

Heat island, Beijing 1987

Heat island, Beijing 2001

灰 霾 Foggy

Short sighted behaviour

- Pollution first, treatment followed
- Construction first, planning followed
- Quantity first, quality followed
- Corruption first, probity followed

Institutional Fragmentation

- Separation resource from environment
- Products from service
- City from countryside
- Economy from social development
- Industry from regional development
- Man from nature

Industrial fragmentation between

- environment & development
- production & consumption
- factory & its surroundings
- wastes producing & recycling
- nature exploitation & restoration
- production units for unused resource sharing / exchanging

Cultural fragmentation

- reductionism dominated philosophy
- cause-effect linked cognition
- discipline isolated science
- nature separated engineering
- problem solving oriented decision making
- mono-scale & local scope planning & management
- historically discrete evolutionary process

Water

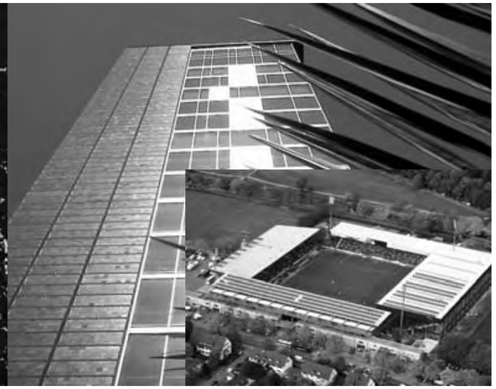
- Water resource
- Water environment
- Water habitat
- Water landscape
- Water disaster

Fire

energy & air

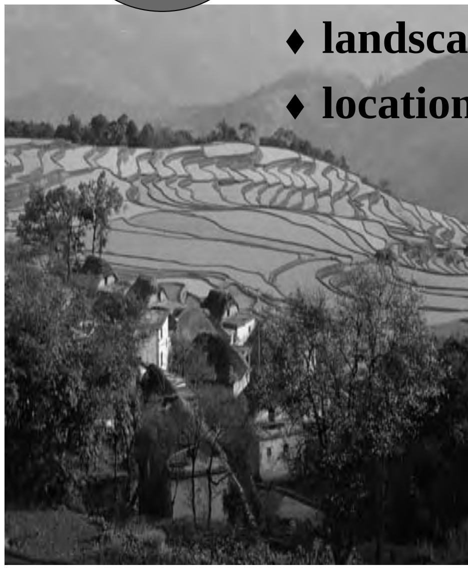
- solar fossil
- climate disaster atmosphere





Soil

- soil
- land
- topograph
- landscape
- location


Wood

- plant
- animal
- microbe
  crop
  pest

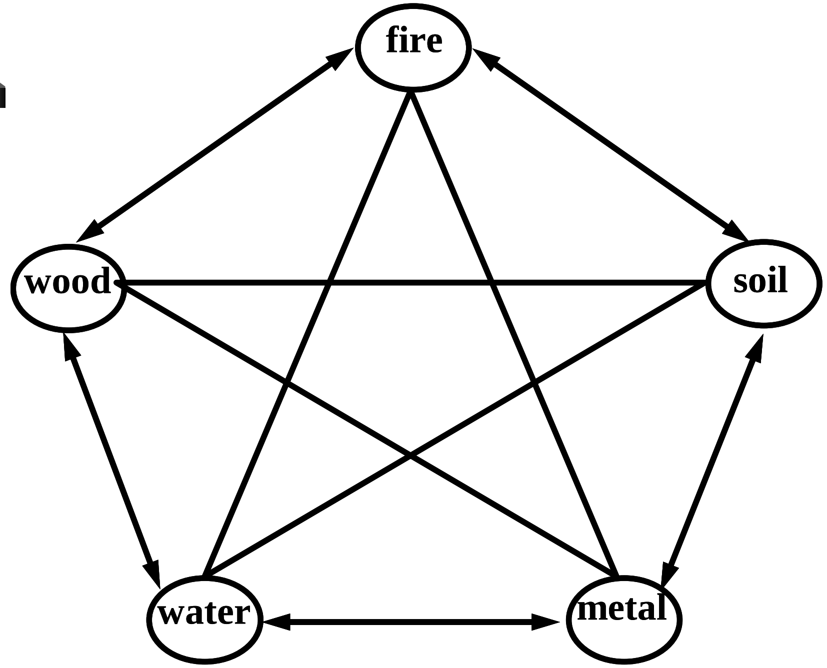


Metal

Geo-chemical cycling

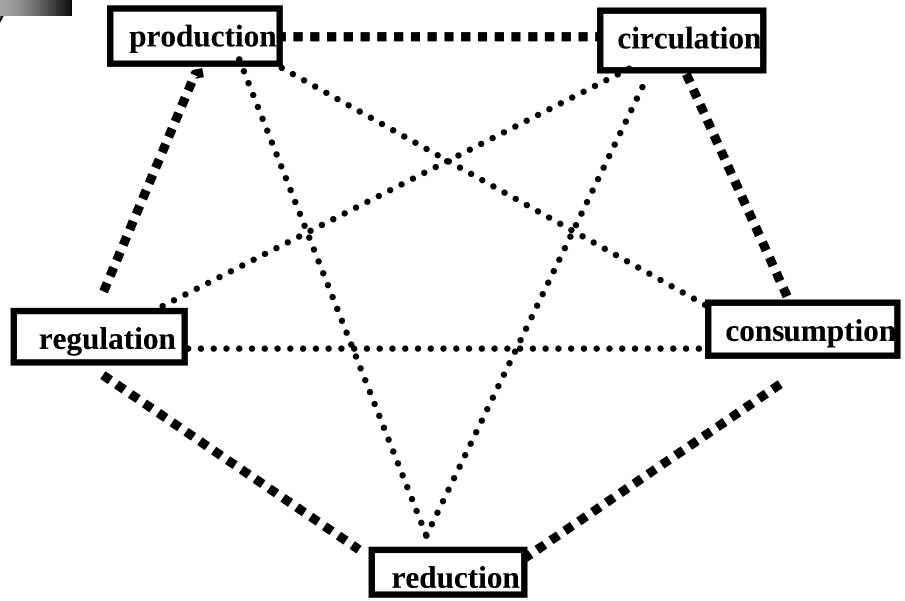
- building material
- metallurgical
- chemical
- wastes
- microelement



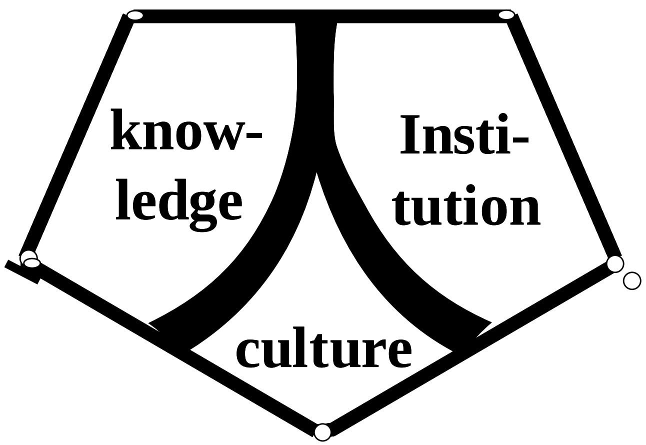


Natural subsystem of SENCE: 5 elements/movements

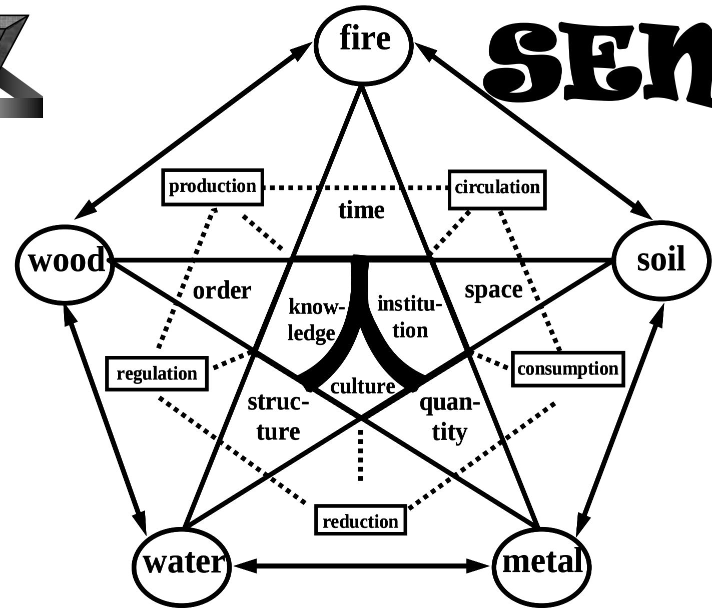
Economic subsystem of SENCE



Social subsystem of SENCE

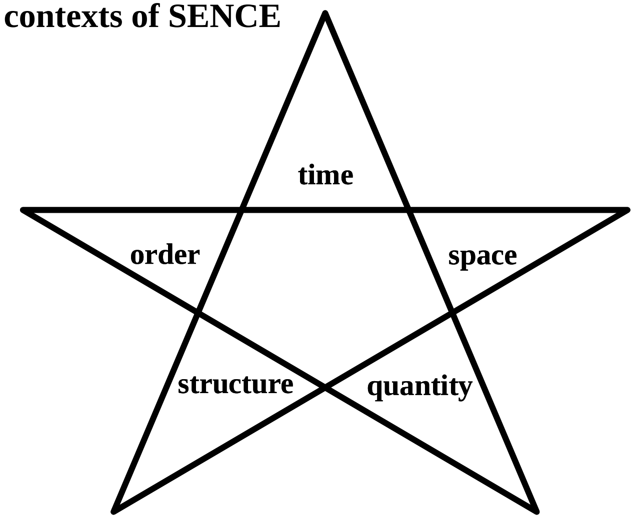


SENCE



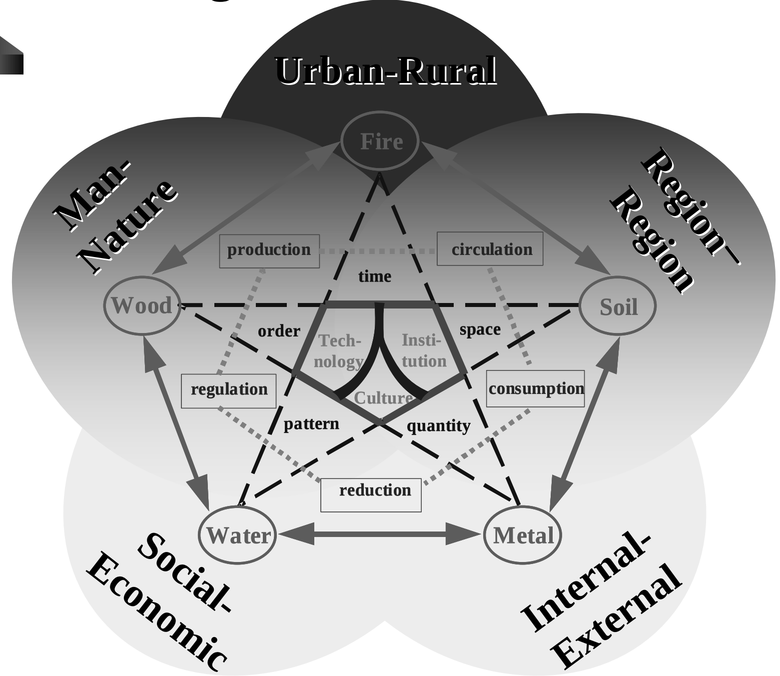
SENCE is a multi-scale, multi-attribute & multi-objective eco-complex bridging man & nature

Scientific contexts of SENCE



Eco-sustainability is to manage the multi scale relationships in time, space, quantity, structure & function within & among the 3 subsystems

Five integration in circular economy



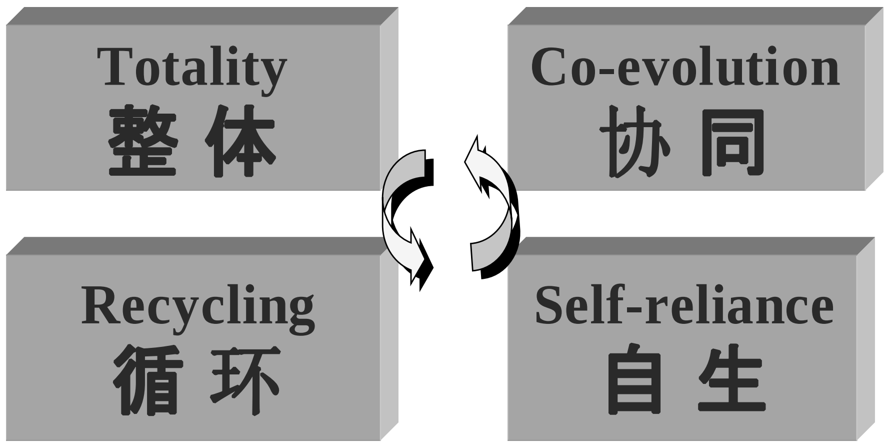
Man have to adapt to Nature:

Chinese Human Ecological Cybernetics

顺天乘势：我国古代的人类生态控制论

- Ying & Yang (+ & -) 阴阳互济
- Wu-Xing (Five-Elements)五行生克
- Zhong-Yong (no extreme)中和庸常
- Feng-Shui (Wind-Water) 风水调和
- Wu-Wei (do nothingness)无为顺治

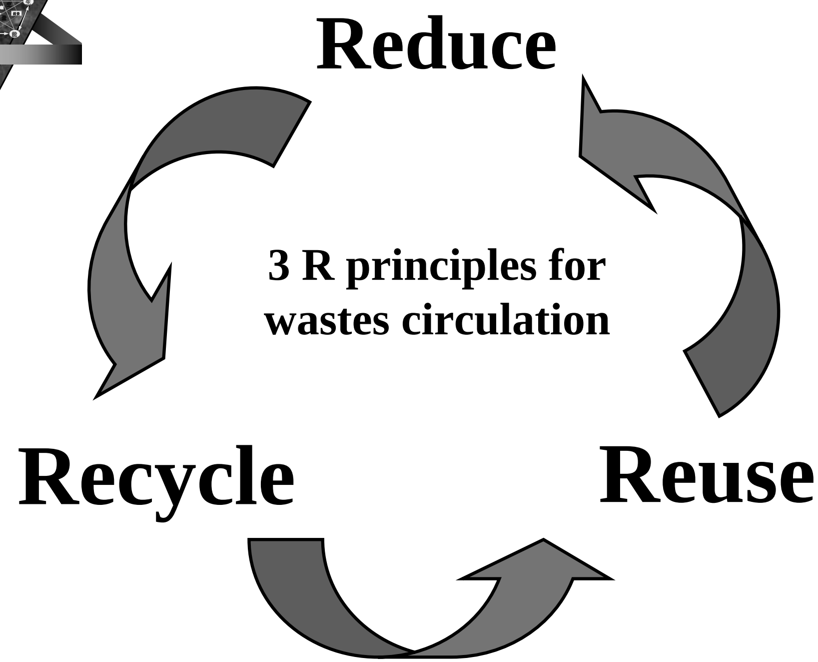
Eco- Cybernetics 生态控制论

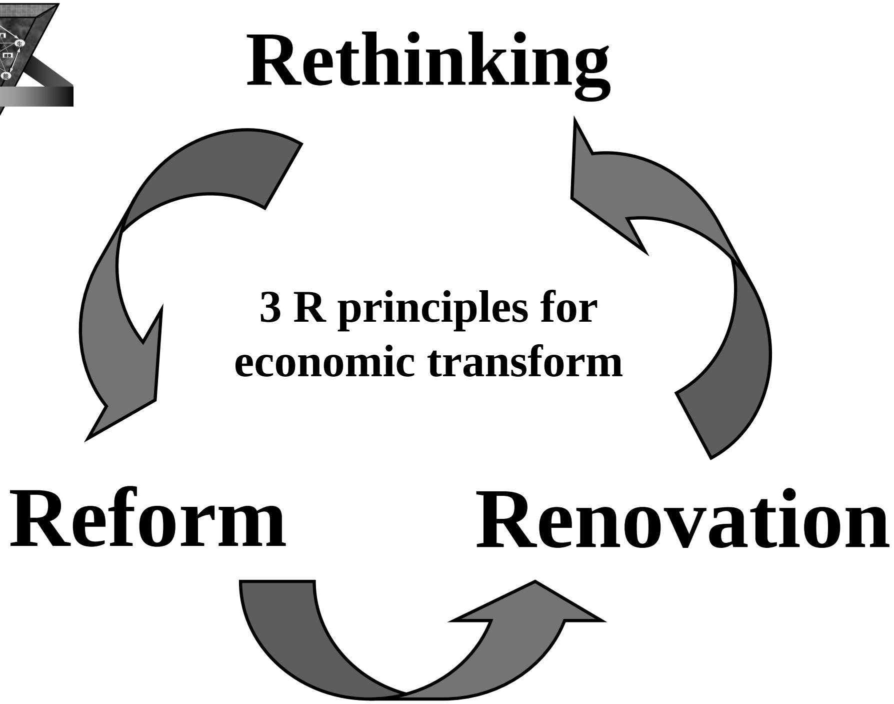


循环经济
Circular Economy

循环经济是按生态经济原理组织起来的基于生态系统承载能力、具有高效的经济过程及整体、协同、循环、自生功能的网络型、进化型复合生态经济。

A kind of networking and adaptive ecological economy operated according to the principles of ecological-economics of "totality, co-evolution, recycling and self-reliance", having high efficiency of resource use, and harmony with surrounding life-support ecosystem.



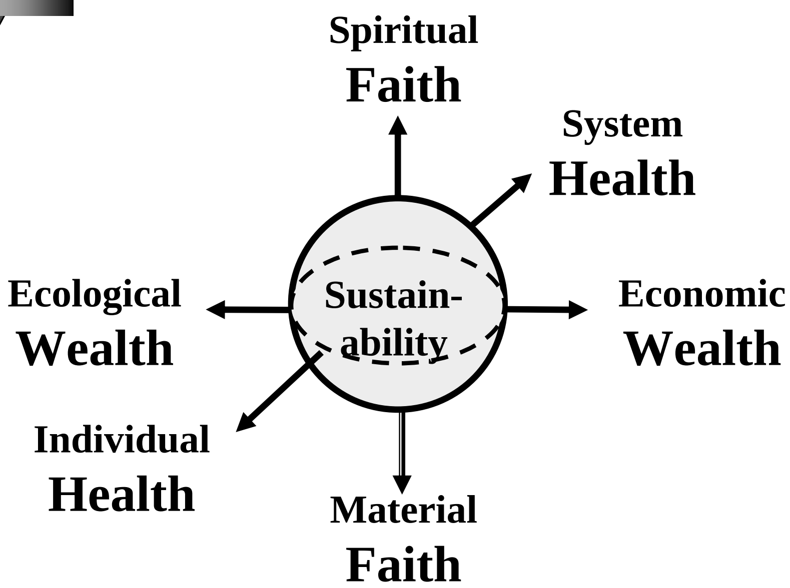


1. *Rethinking*

to induce value change:

- ♦ **from reductionism to holism;**
- ♦ **from environmental exploitation to ecological symbiosis;**
- ♦ **from open materialized cycle to closed ecological cycle;**
- ♦ **from external control to self reliance.**

The Goals of Circular Economy



循环 Recycling

物质循环 material recycling
能量更新 renewable energy use
信息反馈 information feedback
空间和谐 regional symbiosis
时间连贯 temporally sustainable
资金流通 efficient monitory circulation
人力进化 intelligent evolution

2. Reform

to encourage institutional reform

- from chain link to life cycle-oriented vertical/serial coupling;
- from fragmentized and isolated to food web based horizontal/parallel coupling;
- from systematically disconnected to ecosystem-based regional coupling;
- from rigid & non-adaptive to flexible & adaptive production & products structure.

2. Reform

- Multi-scale, inter-sectorial and multi-stakeholders' integration are the key for the institutional reform.
- Hierarchy & networking, dominance & diversity, openness & independence, robustness & flexibility are used to measure the eco-sustainability of structural coupling.

3. *Renovation*

To induce technological innovation

- from technological and products innovation, to functional and system innovation. The focus from material, matter to man. Enhancement of integrative planning & incubation, R & D, Service & Training; Combination of hardware, software and mindware.
- *t*o redefine the economic function through enhancing functional planning, design & management of ecological industry;
- from output and profits oriented to multi-functional service and culture-oriented production;

3. *Renovation*

- from labor decreasing to employment enhancement through creating more jobs in R&D (research & development), I&C (information & consultation), S&T (service & training);
- from slaved employees to respecting human dignity, working is rather a learning and innovation process, a social interactive and self-enjoyment engagement, than slaved by machine and money.

生态产业建设的方法
Instruments of eco-industry

- 观念转型 value change
- 体制改革 institutional reform
- 机制创新 mechanism cultivation
- 技术孵化 technical incubation
- 功能整合 functional integration
- 系统管理 systematic management
- 能力建设 capacity building

A methodological transition
生态建设的方法论转型

Chain link to loop link 开链–闭环

Tree coupling to web coupling 树状-网状

Fragmentation to integration 破碎-整合

Math-optimization to eco-evolution 优化-进化

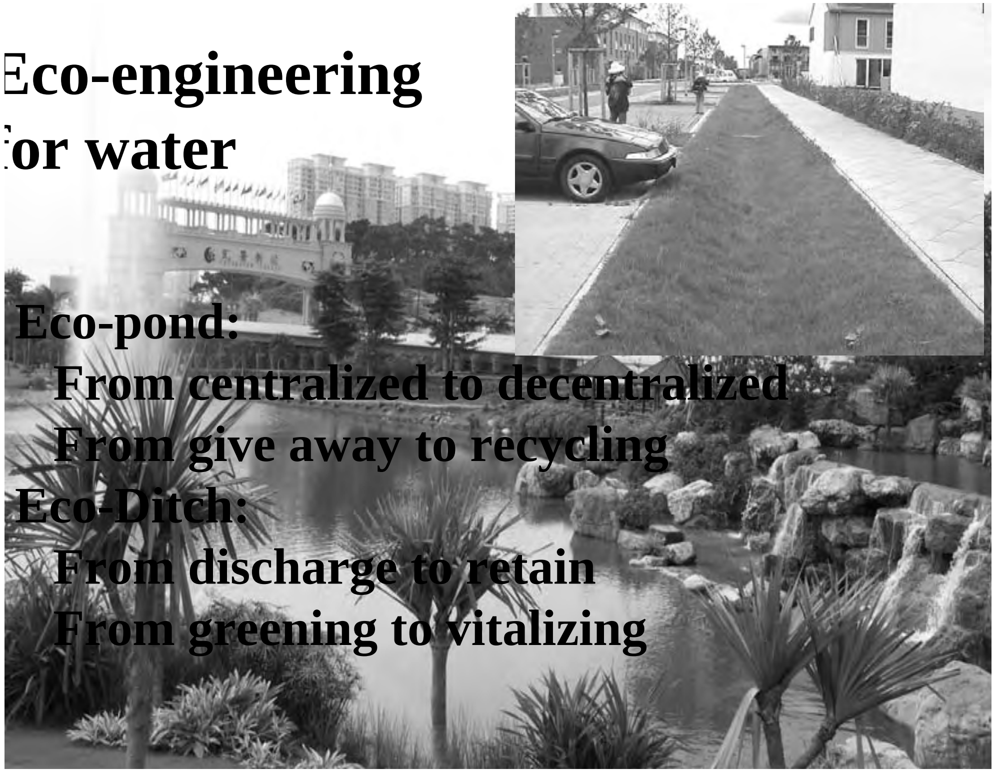
External control to self-reliance 外控-内调

The contents of eco-sustainability

- Eco-sustainability is the development ability of a target system in consistent with ecological cybernetics.
- Exploitation, adaptation, feedback and integration are the main characteristics for eco-sustainability.

The characteristics of eco-sustainability

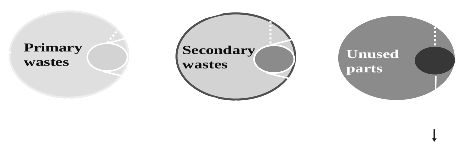
- ♦ self-organization ability of aggression and compensation
- ♦ strong exploitation and adaptation ability to its environment
- ♦ strong competition and symbiosis among its components and with its parent system
- ♦ interlocking negative and positive feedbacks to maintain its functional development and against risks



III. Reform an eco-industry : the Characteristics of Circular Economy

Characteristics of Eco-industry

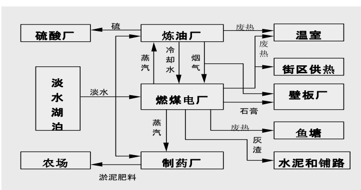
1. Life cycle coupling (vertical):
connecting primary production, manufacture, distribution, consumption and regeneration into one eco-industrial complex to let the production more systematically responsible;



纵向闭合

Characteristics of Eco-industry

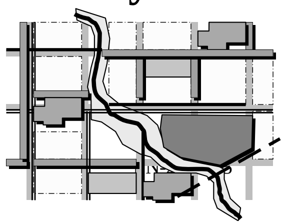
2. Food web coupling (horizontal):
connecting the different production processes & to gain positive benefit from the negative environmental impacts through sharing unused resources.



横向耦合

Characteristics of Eco-industry

3. Ecosystem coupling (regional):
recoupling of neighbor environment, local community, dominant enterprises & other diversified sectors into one industrial ecosystem in order to internalize environmental costs & pollution could be assimilated & minimized within the system itself;



区域整合

Characteristics of Eco-industry

4. Social integration:

Multi-functional management of the enterprises, communities & nature's common, providing local people with work opportunity, participation chance, social and natural service and appropriate environment, cultivate a harmonious enterprises and community culture.

社会融合

Characteristics of Eco-industry

5. Flexible and Adaptive structure:

multiple production function, diversified products and easy-to-change process rather than rigid, unified and imitation one to adapt to the external change;

结构柔化

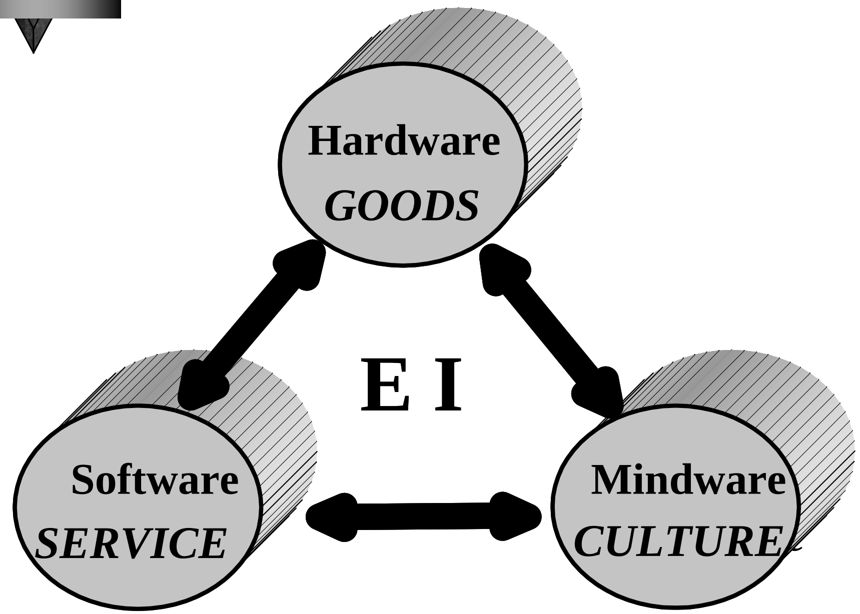
Characteristics of Eco-industry

6. Service oriented functional outputs:

switching the products & profits oriented industry to process & service orientation with three kinds of final outputs: hardware (products), software (services) and mindware (culture) ;

功能导向

3 Goals of Ecological Industry



Characteristics of Eco-industry

7. Capacity building: enhancing the capacity of R&D (research and development), I&C (incubation and consultation), S&T (service and training) sector, adaptive and comprehensive decision making, sensitive information feedback, effective networking of knowledge, experiences and experts.

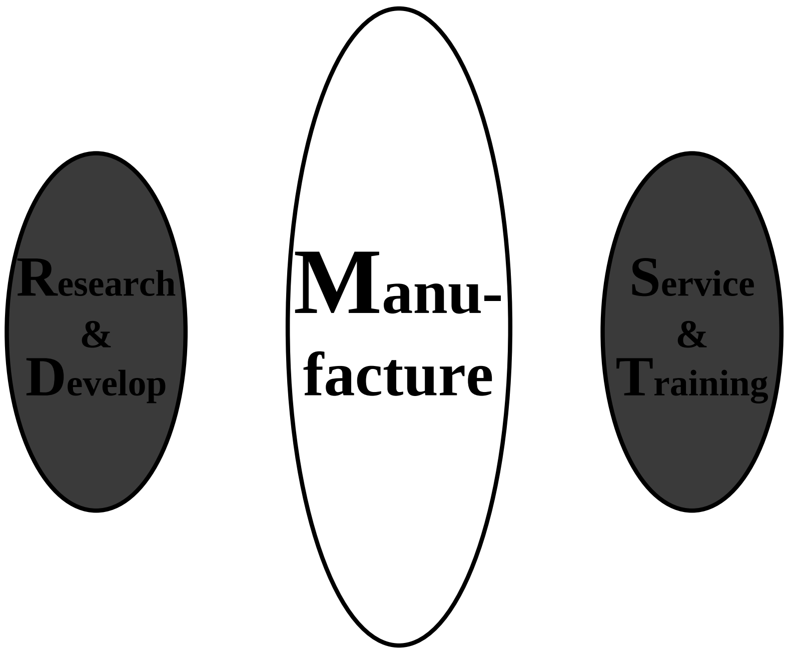
能力组合

Characteristics of Eco-industry

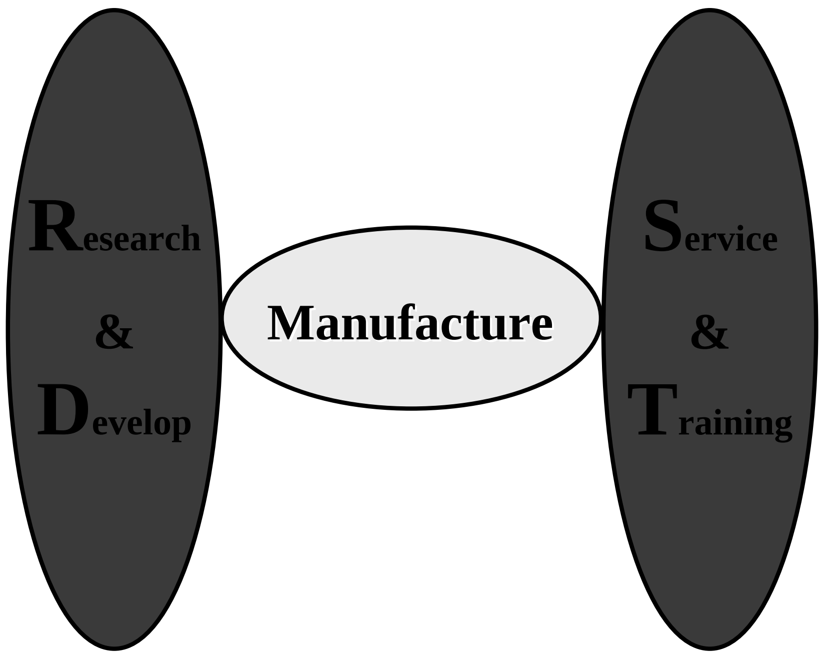
8. Employment: increasing rather than decreasing working opportunity especially through creating labor-intensive service sector within the industrial ecosystem;

增加就业

The Employment of traditional Industry



The Employment of Eco-Industry



Characteristics of Eco-industry

9. Respecting human dignity:
working is a learning and innovation process, a social interactive and self-enjoyment engagement, rather than slaved by machine and oriented mainly to earn one's salt;

人性生产

The combinatory EI model

- **Learning model**
- **Planning model**
- **Regulation model**

Social learning model of EI

- **Dynamics model for understanding the main driving forces and main metabolism processes;**
- **Cybernetics model for understanding main positive and negative feedback, and main risk and opportunities;**
- **Contexts model for understanding the temporal evolution, spatial pattern, metabolism balance, institutional coupling & functional order.**

Adaptive Planning model of EI

- **Key Identification Model (key limiting, promoting, buffering and critical factors, key dominating & compensating components & key negative and positive feedback);**
- **Partial Simulation Model (problem diagnosing, process tracing, policy testing);**
- **Adaptive Optimization Model (pan-objective ecological programming).**

Interactive Regulation model of EI

- **Eco-engineering Model** (technological innovation to incubate totally functioning technology);
- **Eco-governance Model** (institutional reform to cultivate systematically responsible institution) ;
- **Eco-culture Model** (behavioral inducement to encourage ecologically vivid culture).

Functional coupling

- ***Exploitation & Adaptation***
- ***Competition & Symbiosis***
- ***Proliferation & Compensation***
- ***Exhaustion & Stagnancy***

EI evaluation Methods

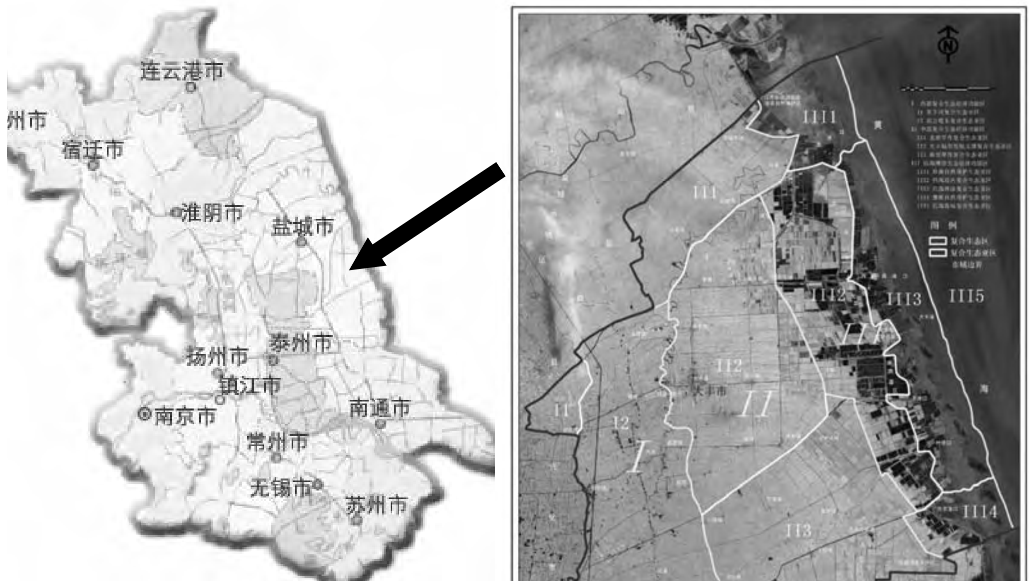
- **Life Cycle Assessment (M)**
- **Industrial Metabolism (M)**
- **Input-Output Analysis (M)**
- **Emergy Analysis (E)**
- **Ecological footprint (S)**
- **System dynamics (T)**
- **Scenarios of development strategy (T)**
- **Bio-cybernetics (I)**
- **Eco-service assessment (I)**
- **Ecological risk assessment (I)**
- **Eco-goods evaluation ($)**

Cases of EI Initiation in China

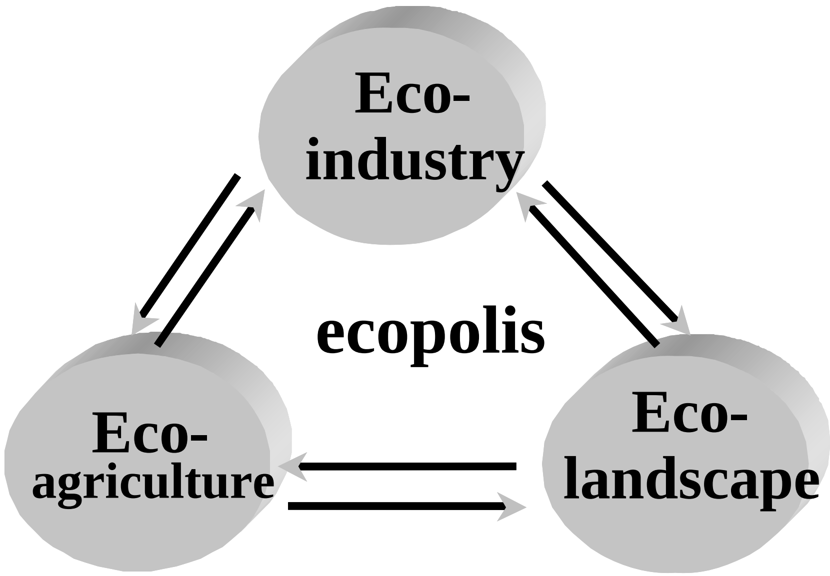
- **2,000 eco-agricultural experimental cases**
- **Zhaodong Corn-based eco-industry**
- **A pilot ecological engineering for municipal solid wastes recycling**
- **Dafeng agro-industrial eco−county development**
- **Eco-building industry developed in Jinghua**
- **Lianhua Monosodium Glutamate based agro-industrial park**
- **Macun eco-industrial park transformed from old industries**

IV. Dafeng：15 years' experiences & lessons of Ecopolis Development

Dafeng/Jiangsu: people: 740,000 land: 2376km^2



Three Goals of Dafeng Ecopolis Planning & Management in 1987



3 Phases of Dafeng Ecopolis Development

Phase I (1990-2005)

Value Change & Capacity building

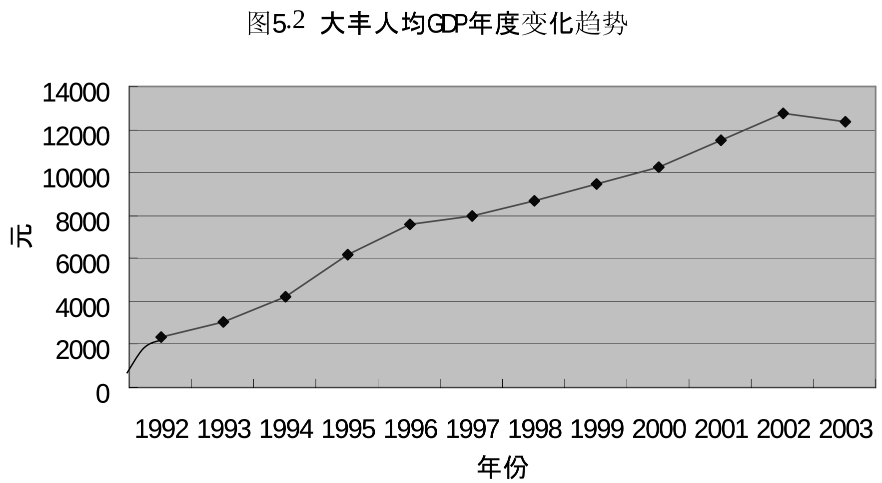
Phase II (2005-2020):

Institutional & Functional Transition

Phase II(2020-):

Optimization & Harmonization

Dafeng Economic Development



15 years' achievements of Dafeng Ecopolis Development

- Dafeng, a less developed and average level county in 1980s, has been jumped to & ranked at the 100 strongest counties in economic development among 2862 counties in China since 2002.
- The GDP and revenue of the county of 2004 has been increased by 16 and 13 times respectively compared with that of 1986.
- Urban population ratio rised from 16.5% in 1992 to 38.7% in 2004.

15 years' achievements of Eco-Dafeng Development

- Population has been sustained in a stable level with a increase rate of –0.01‰ in 2004, otherwise 200,000 more population would be added compared with neighbor regions in the past 15 years.
- Around 200 km^2 emerged coastal land have been appropriately reclaimed for wetland conservation forest and fishery development in 15 years

Population decrease **land increase**

15 years' achievements of Eco-Dafeng Development

- The average life expectancy goes from 71.05 in 1986 to 73.47 in 2004;
- Soil organic content goes up from 1.19% in 1986 to 1.45% in 2004;
- Forest coverage has been increased from 10.61% in 1986 to 17.6% in 2004;
- The core area of National Reserve of crowned crane and David's deer doubled & the deer population has been increased by 10 times .

15 years' achievements of Eco-Dafeng Development

- Water productivity increased from 1.40kg/m^3 in 1990to 1.71kg/m^3 in 2004;
- The organic and green food production ratio increased from 0 in 1990 to 12% in 2004 ;
- Urban green area per capita increased from 1.86m^2 in 1989 to 4.56 m^2 in 2004;
- The eco-awareness of decision makers, industries and ordinary peoples is much higher than that of neighborhood.

15 years' achievements of Eco-Dafeng Development

- More than 30 National Awards/Honors in national greening, forestation, agro-environmental protection, energy development, education, culture, science, sanitation and other social development have been conferred to the county by relevant ministries in past 15 years.

Main measures of Dafeng ecopolis management

(1) Multi scale ecological integration and economic adaptation

- 5 types of coordination between economic and ecological, agricultural & industrial, urban and regional, territorial & coastal, and between internal & external development across multi scales from household, village, industrial park, town, watershed, region to remote area such as Shanghai.
- 6 kinds of ecological models for coastal wetland conservation & reclamation have been developed.

Main measures: Eco-agriculture

- crop – livestock – processing mixed,
- family- farm-factory-enterprises integrative
- local-regional-global cooperative

multi-scale and multi-dimensional eco-agro-industry;

Main measures：web-linked eco-industrial complex

- Farming-manufacture-trade
- cotton planting--ginning—filature--weaving--printing & dyeing—clothing integrative textile eco-complex

Main measures：regional eco-integrity

- Established two ecological industrial parks to promote eco-complex incubation and let heavy pollution and resource intensive industries entering into the parks for intensive treatment
- Promote regional cooperation among production-consumption-nature conservation sectors through eco-town & eco-infrastructure development

Main measures of Dafeng ecopolis management

(2) Institutional reform and juristic support

- Dafeng ecopolis planning was adopted by the county's people's congress and Yancheng prefecture and Jiangsu province government in 1989.
- A special eco-county coordination agency under the mayor was set up, responsible for its institutional reform, systematic planning, integrative decision–making, people's participationg & behavioral inducement.
- The experience of Dafeng ecopolis planning and management was disseminated to whole Jiangsu province, most cities and counties in the province had made their own ecopolis planning and relevant institutional and juridical measures.

Main measures of Dafeng ecopolis management

(3) Technological innovation

- 22 demonstration sites for ecological engineering have been organized in the county.
- An eco-agricultural system has been set up in 249 villages.
- 10 comprehensive eco- engineering aiming at deep processing and effective use of agricultural resources have been developed.
- More than 150 village–and–township enterprises were developed within the ten projects.

Main measures of Dafeng ecopolis management

For example:

- Dafeng Brewery has realized zero emission & productive wastes treatment through integration of brewing industry–aquaculture– agriculture & piggery subsystems;
- Dafeng Chemical Fertilizer Factory develops a closed recycling system where the wastes recycling ratio is as high as 95%.
- There are 22000 technicians, 100 technological societies and 10 technological service systems in Dafeng county.

Main measures of Dafeng ecopolis management

(4) Value change and capacity building

- Value change and concept formulization of Decision-makers, managers and enterprisers are especially stressed.
- The ecological concept of integration, adaptation, recycling and self-reliance was well understood & incorporated into Dafeng ecopolis development.
- Various training courses, vocational education and technical consultants to catalyze S & T.
- A cooperation between Dafeng and outside research institutes, enterprises and relevant agencies is well developed.

Demonstration project for sustainability

- MOST: National Demonstration District of Local Agenda 21
- MOA: National Green Products Base
- FAO: Pilot Project of Sustainable Agriculture and Rural Development
- World Bank: One of the 5 Global Cases for Ecological Agriculture

Scientific cooperation with

- USA , Denmark, Swiss land, UK, Japan, World Bank, FAO, etc,
- Projects from more than 15 ministries,
- Scientists from hundreds of universities and research institutes in Beijing, Shanghai, Nanjing and other cities of China

Bottleneck of Dafeng ecopolis management

- Dafeng eco-county planning finalized in 1989 was not completely put into implementation.
- Most of the chain industry was not entirely brought into practice or failed to execution.
- The main reason is the inconsistence of its ideal planning with its unsustainable social and economic environment.

Bottleneck of Dafeng ecopolis management

- the pressure of unreasonable economic structure
- the resource-intensive production mode, &
- the unreasonable spatial layout

also resulted in environmental pollution due to the static and fragile coastal plain water network.

Lessons & challenges

Institutional barrier

Behavioral bottle neck &

Technical malnutrition

Bottleneck of Dafeng ecopolis management

Dafeng ecopolis development suffered from many institutional, cultural and technological conflicts

- between ecological integration and fragmentized institution;
- between ecological theory and economic practice;
- between GDP orientation appraisal system for politician's achievements and the ultimate goal of Ecopolis development;
- between internal and external policy environment;
- between long and short term development goals;
- between local and regional efficiencies.

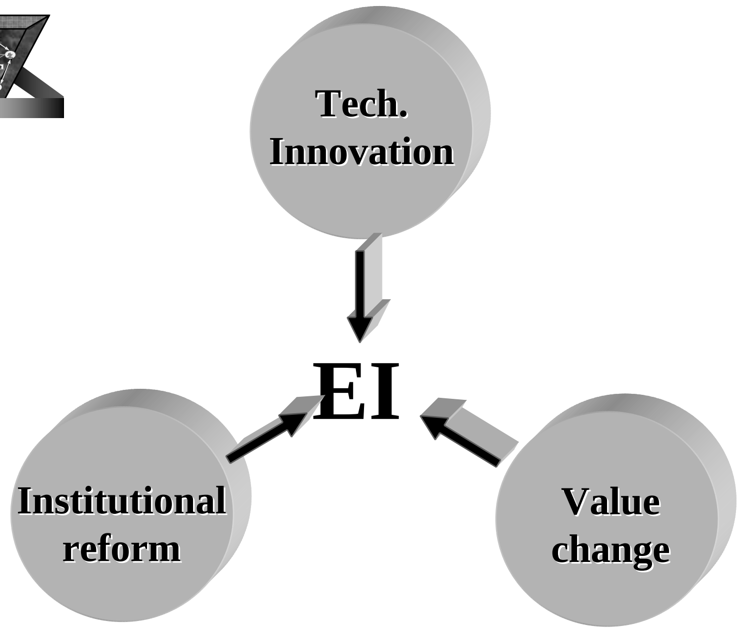
Bottleneck of Dafeng ecopolis management

Dafeng case shows that successful ecopolis development requires

a set of innovatory leaders, advanced hard and soft technology, multi-scale institutional coordination, technology incubation system, information dissemination and capacity building network;

Main Challenges

- fragmentized institution in sectors and times
- external inconsistence policy
- week legislation
- unqualified intelligence
- week information feedback
- lacking incentives of governance achievements appraisal
- lacking ecosystem based resource management
- low investment on eco infrastructure
- low input on R&D, S (service) & T (training)



Main Challenges in Eco-Industry Transition

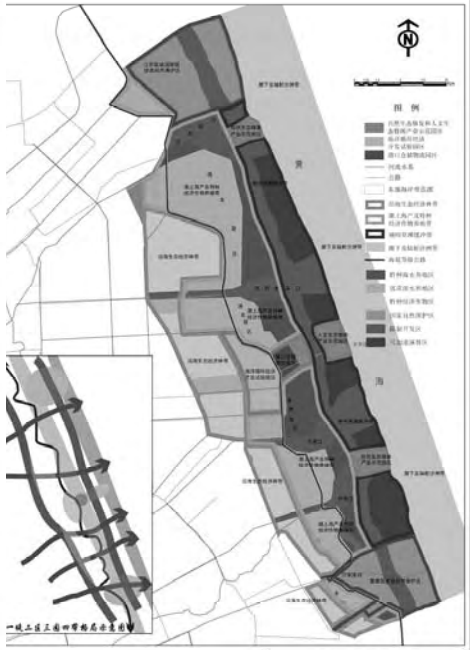
Next 15 years: Stratigic Focus

- foreshore cultivation and conservation
- watershed service focused eco-sanitation
- renewable energy development (wind, solar and biomass)
- industrial transition towards solar products induced industry, land based human & natural eco-service industry, & ocean based potential comprehensive industry
- promote agro-industrialization, rural modernization and regional urbanization through symbiosis between company & farmers, farms & villages , agriculture & manufacture

Next 15 years: Strategic Focus

- Regional cooperation between Shanghai & Dafeng based on Shanghai owned farms to make advantages of Shanghai's technology, investment and market, and Dafeng's land, environment and landscape;
- Old industry transition, new industry incubation, technical catalyzing, integrative planning and self-reliance management。

Dafeng ecopolis zoning

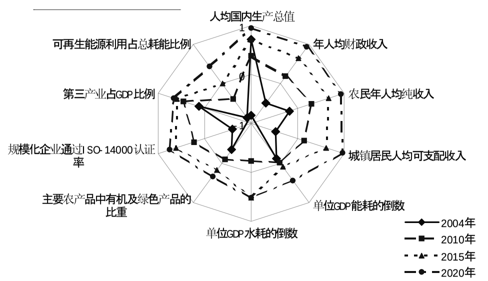


Coastal area planning

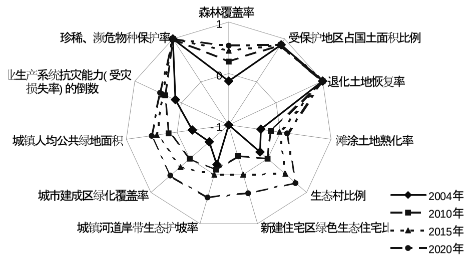
Next 15 years:

Dafeng Ecopolis

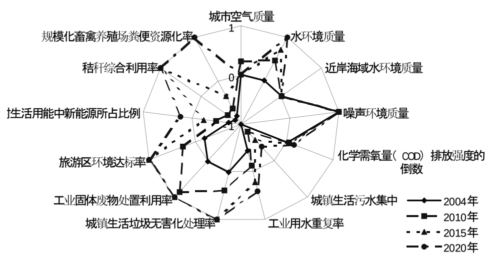
- healthy environ.
  - Eco-service
    - watershed
    - biodiversity
    - farmland
    - foreshore
    - landscape
  - Settlement
    - transport-
    - energy
    - wastes
    - greening
    - Architect
- circular economy
  - Ind. Transition
    - solar-based resource Ind.
    - old. Ind. transition
    - leisure & service Ind.
    - eco-restoration
    - sea industry
  - EIP/network
    - EI incubation
    - Eco-products demonstration
    - Pilot study of eco tech.
    - Information network
    - Social service
- harmony society
  - Social dev.
    - Planning & management
    - Population & employment
    - Education & health care
    - Urban network
    - Social insurance
  - eco-culture
    - institution
    - knowledge
    - tangible culture
    - intangible culture
    - spiritual



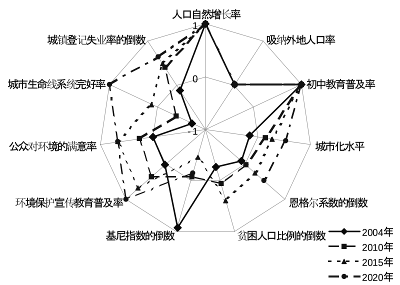
Dafeng economic development



Dafeng ecological infrastructure



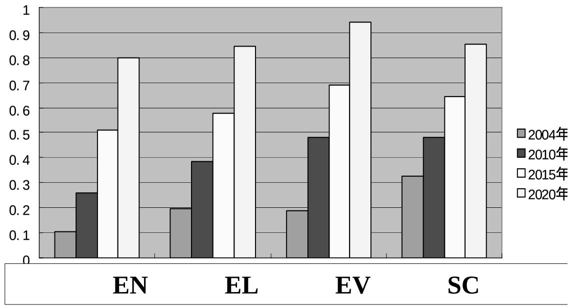
Dafeng environment protection

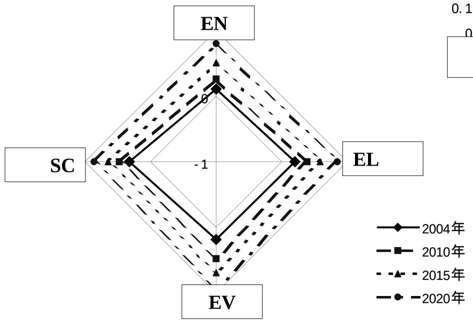


Dafeng social development

Comprehensive sustainability assessment

EN: economic development
EL: ecological development
EV: environment protection
SC: social development





CONCLUSION

Industrial Transition

- Value change : from linear to system thinking
- Production: from chain to network coupling
- Life style: from materialization to dematerialization
- Capacity building: from economic to ecological intelligence

Eco-Industrial Complex -- a kind of SENCE

- Eco-dynamics: energy, money, power & spirit
- Eco-cybernetics: totality, symbiosis, recycling & self-reliance
- EI outputs: hardware, software & mindware
- EI interference: technology, institution & culture
- EI goals: wealth, health and faith
- EI contexts: time, space, quantity, configuration & order

Capacity Building for IE

- 从科学层面认识生态（scientific understanding）
- 从体制层面管理生态（governance）
- 从工程层面建设生态（engineering）
- 从社会层面宣传生态（medium）
- 从美学层面品味生态（aesthetics）

Profile

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Education:

1965-1970	B.S., Mathematics, Wannan University, Wuhu, Anhui Province
1978-1981	M.S., Mathematical Ecology, The Chinese Academy of Sciences, Beijing
1982-1985	Ph.D., Systems Ecology, Chinese Academy of Sciences (CAS), Beijing

Professional Career:

1981-1982	Research Associate, Research Center of Ecology, CAS
1986-1989	Associate Professor, Research Center for Eco-Environmental Science, CAS
1986-1996	Director, Key Lab of Systems Ecology, Chinese Academy of Sciences
1990-2006	Professor, Research Center for Eco-Environmental Sciences (RCEES), CAS

Committee/ Boards:

2002-2008	Vice President, The Scientific Committee of the Problems of Environment/ICSU (SCOPE).
2000-2009	Board member, International Society for Ecology
1998-2005	Board member, International Society for Ecological Engineering.
2001-2004	Vice President, Society for Human Ecology (international)
2002-2008	Delegate of China's National Peoples Congress
2004-2008	President, Ecological Society of China.

Research Fields/ Interests:

Systems Ecology, Urban ecology, Industrial Ecology, Sustainability Science and Policy analysis

Selected Publications:

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Current Environmental Issues in South Korea and Policies toward Sustainable Society

Jung Wk Kim, Ph.D.
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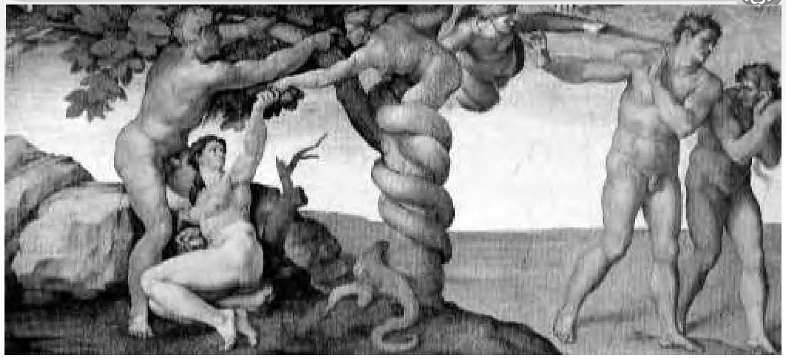
Abstract

For decades, South Korea has indulged in developing growth- and supply-oriented economy while paying little attention to the environment. Such development worked for a time, but such development is not so economically efficient as hoped. Rather it poses a dangerous threat to the land and people. The ultimate goal of the nation's policies should be aimed at environmental sustainability, not economic indices. Our economic activities should not be allowed to exceed the land's carrying capacity to endure. The land use should be planned from an ecological point of view so as to best preserve the land's productivity and stability. In that sense, there should be a definite goal on where and how much to preserve the three important ecological bases in the Korean Peninsula, namely, forests, coastal wetlands and agricultural farms. The forest is the base for terrestrial ecosystem like flood control, water resource, climate and others, the coastal wetland for marine ecosystem and farmland for producing food. Within that goal, the limits should be set on how much the land can be utilized for activities like urban development, manufacturing, recreation and others. And the limits of pollution loads resulting from such activities should be set so as not to irreversibly damage the environment. The economic development should be planned to minimize the use of energy and resources only after satisfying these constraints. Energy efficiency should be upgraded and an efficient recycling system should be established to save energy and resources and to reduce waste volume. The industrial structure should be reformed so as to be environmentally friendly and pollution should be cleaned up. Korea's environmental problems cannot be fundamentally solved without first solving the Northeast Asia's regional environmental problems, such as trans-boundary air pollution, marine pollution, and conservation of endangered species, all of which need to be solved through international cooperation.

Current Environmental Issues in South Korea and Policies Toward Sustainable Society



Jung Wk Kim
Graduate School of Environmental Studies,
Seoul National University

Environmental Ordinances
posted in villages

80 lashes for dumping ash
100 lashes for loosening cattle

Traditional Environmental Ethics

o Environmental Crimes :

punished by **constitution**

during Chosun Dynasty (1392-1897)

o Ordinances :

> 30 lashes for dumping **ash**

> 50 lashes for dumping **nightsoil**

100 lashes for loosening cattle

* Mosaic Law prohibits 40 lashes or more

o Forest : **Forbidden Mountain**

100 lashes	for logging 1 pine tree
100 lashes + military service	for logging 2 pine trees
100 lashes + deport to Manchuria	for logging 10 pine trees

- **Resource Recycling Society**
  - Food Waste : animal feed
  - Ashes and Manure : fertilizer
- **Clean Environment**
  - Rivers : drinking water quality
- **Sustainable Community**

Houses :
built so as to minimize energy use and environmental burdens

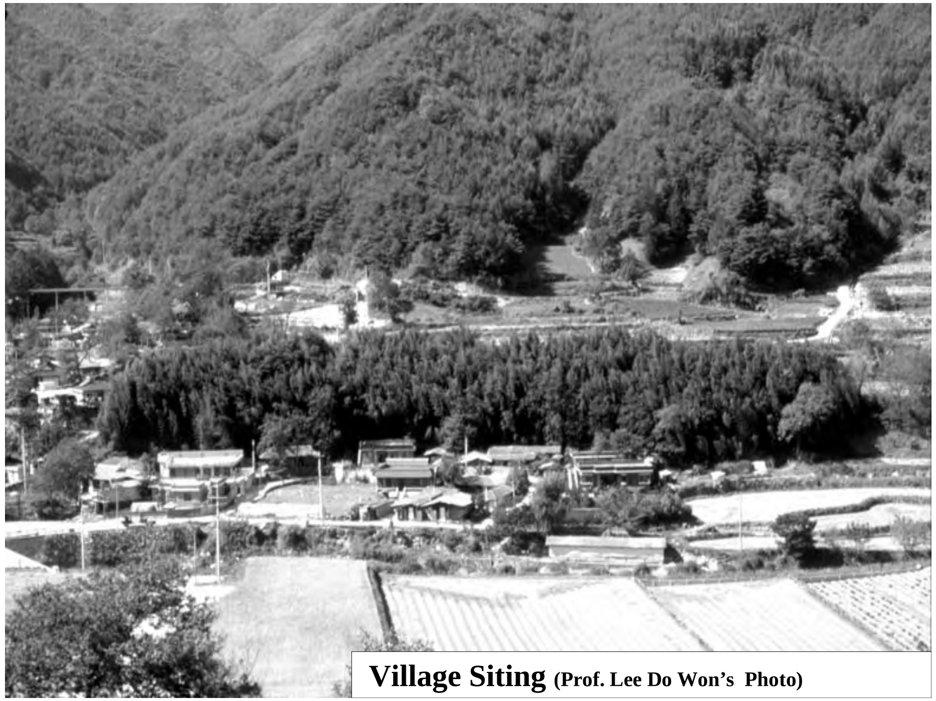
* **Ondol**

Towns and Cities :
siting & landuse : environmentally- friendly

forests protected
'forbidden mountain'
'tree planting club'

population controlled **< 200,000**

Traditional Korean Village **(Prof. Lee Do Won' Photo)**



Village Siting **(Prof. Lee Do Won's Photo)**

Riparian Treatment **(Prof. Lee Do Won's Photo)**

Environmental Exploitation by Japan

o Meiji Government established in 1868

Two mottos: 1. **Military power**

2. **Industrialization**

Resulted in resource exploitation backed by military forces

o Forest exploited since 1890's

70% of Forest Resources gone between 1910–1945

. especially severe during the last stage of WW II

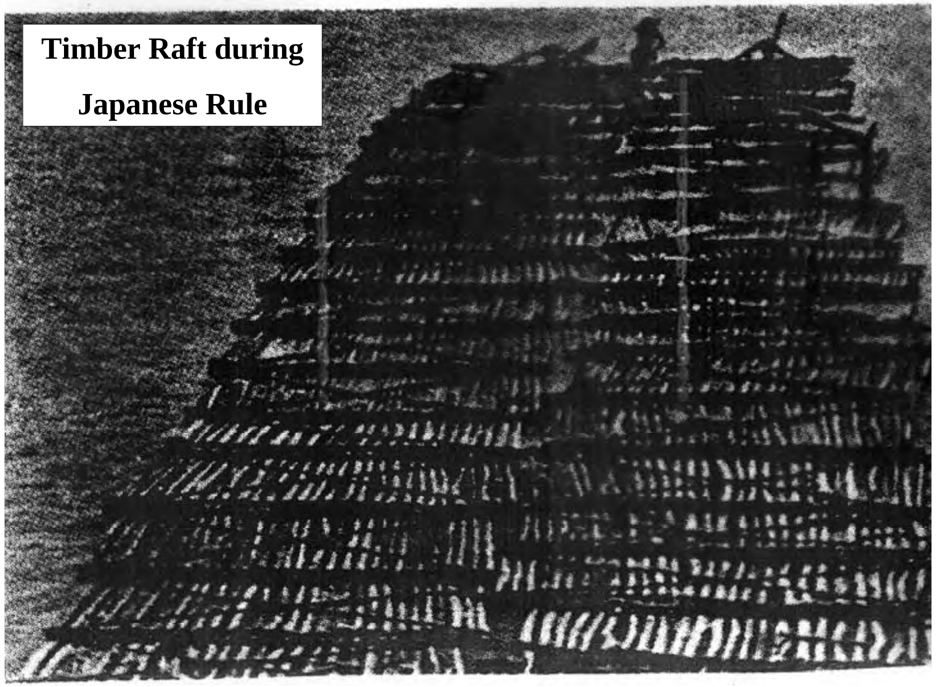
Deuteronomy 20:19

"When you lay siege to a city, do not destroy its trees by putting ax to them, because you can eat their fruit for the tree of the field is man's life"

Korean Forest during the Japanese Rule

(Yeoju, Kyeong-gi, late 1930's)

Timber Raft during Japanese Rule



Environmental Degradation during Industrialization

- 1st 5-yr Economic Devel. Plan in 1962
  - Environmentalists = Traitors
  - Pollution Prevention Law = Pollution Promotion Law
- Pollutive Industries Invited
  - TNCs in Ulsan/Onsan account for
    - 34% of production, but
    - 80% of hazardous wastes
    - 100% of toxic gas spills
- Korean Industrial Structure
  - Pollution-intensive
  - Energy-wasteful

Lawrence Summers

"Export pollution to Developing countries"

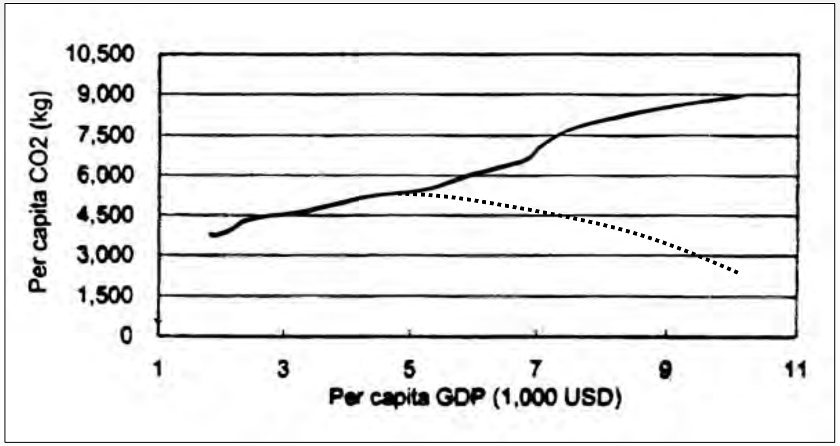
1. *Compensation is cheap.*
2. *Underpolluted.*
3. *Their lifespan is short .*

Foster, J.B., "'Let Them Eat Pollution': Capitalism and the World Environment", Monthly Review, January 1993, 10-20.

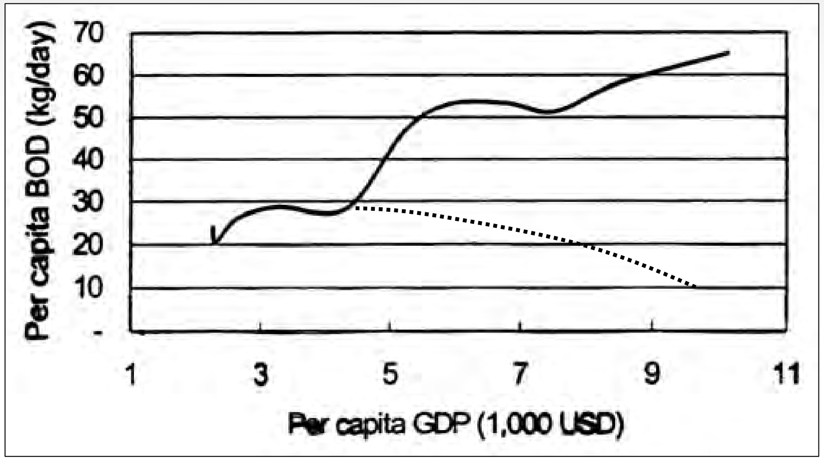
Fate of Rayon Factory

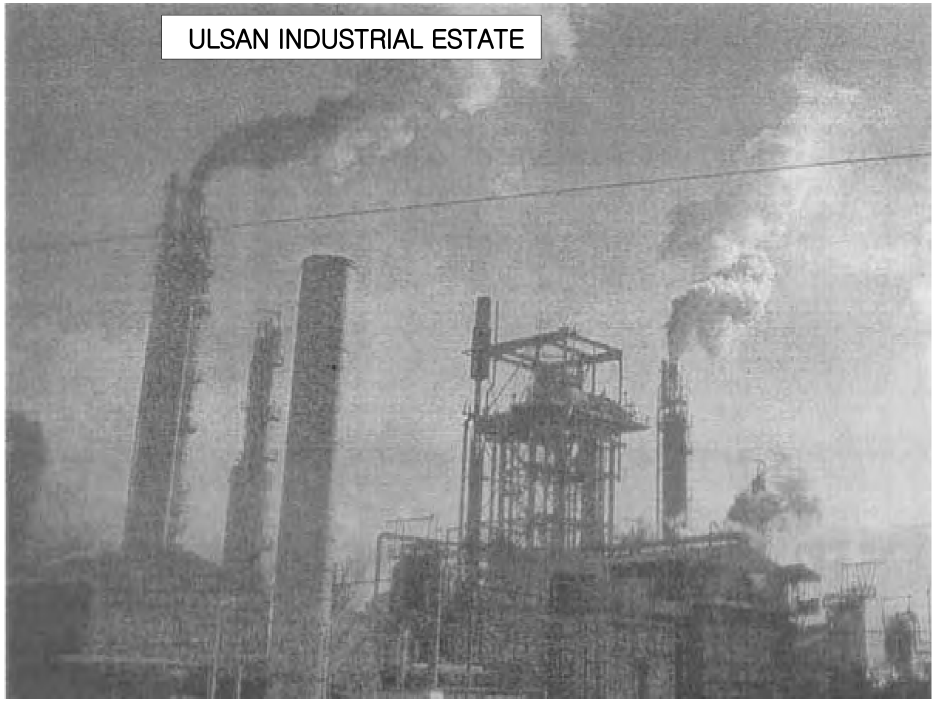
USA ⟶ Japan ⟶ S. Korea ⟶ China ⟶ ???

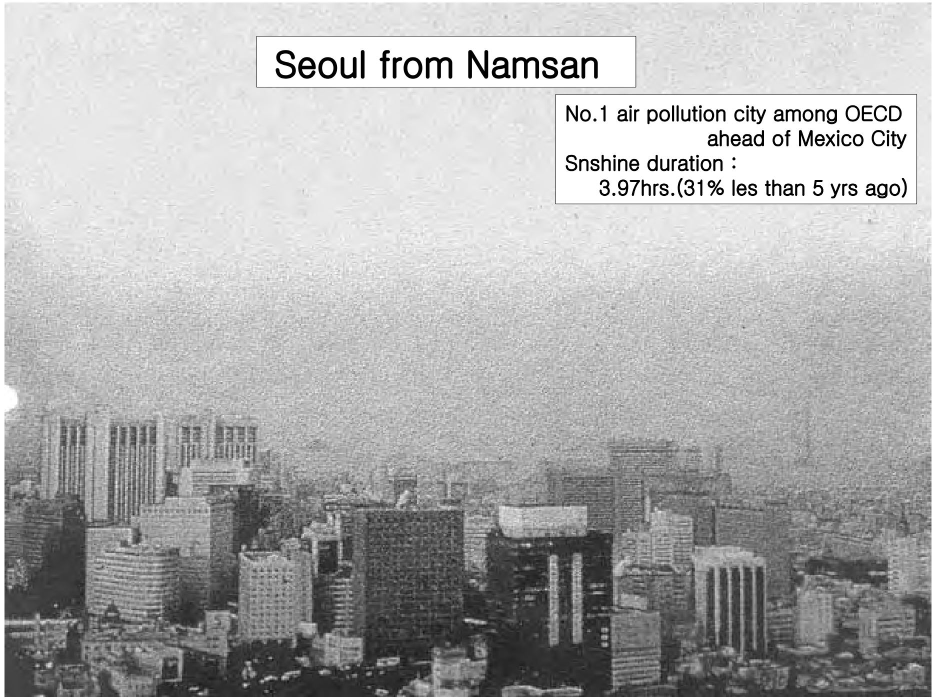
The Relationship between
Per-Capita GDP and CO_2 in Korea
(does not follow the Kutznet Curve)



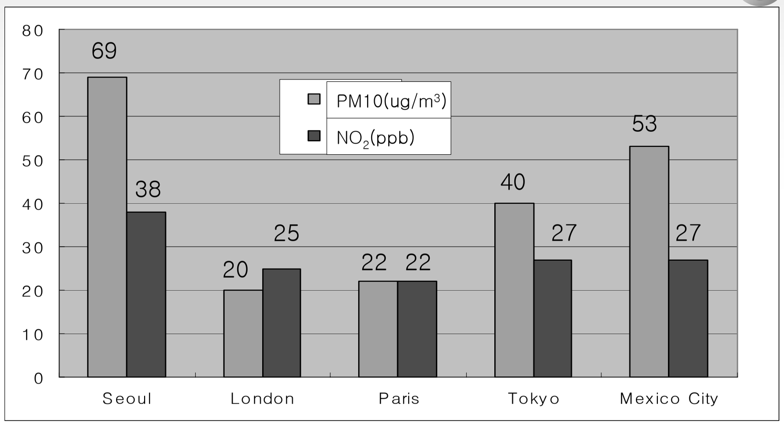
The Relationship between
Per Capita GDP and BOD in Korea







Air Pollution Level of Major Int'l Cities



Health Damage due to Air Pollution In Capital Area

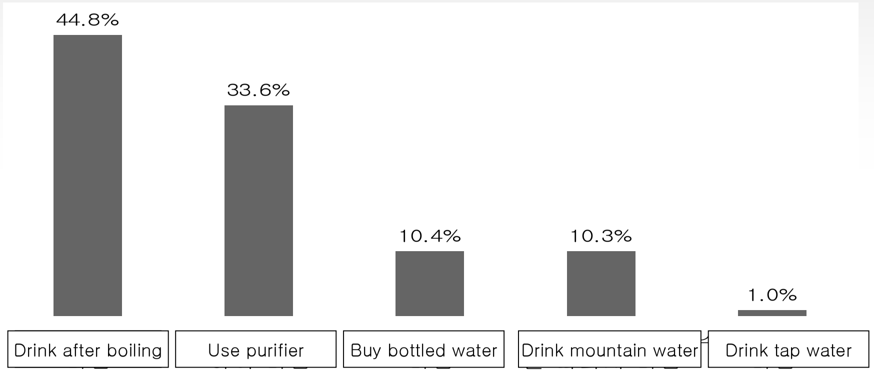
early death	: ~	11,127 persons/yr
respiratory diseases	: ~	16,804
chronic bronchitis	: ~	7,808
acute bronchitis	: ~	1,223,396
acute respiratory diseases	: ~	1,693
cardiopathy	: ~	31
asthma	: ~	544

----

total cost: 2.8 ~ 10.4 trillion ¥/yr

How do you drink water?

(Survey by Ministry of Environment, 2003. 8)



Environmental comparison (2004)

Korea vs. Japan

	Korea	Japan
GNP	1	7
Per capita income	1	2.6
Population	1	3
Area	1	4
SO_2 emission	**4.4**	1
BOD emission	**20**	1 (2000)
Toxic Waste emission	**4.5**	1
Per-capita energy use	**1.05**	1
		(ahead of Ger. Fra. Ita. GB)
Energy/GNP	**2.7**	1 (Top among OECD cnountries)

Future Prospect (Plan)

	1990	2000	2010	2020
population	44.5 m ------------->			50.0 m
income	$7000 --------------->			$30,000
autos	10 m ---------------->			25 m
industrial area	150 km2 ----------->			380 km2
water use	535 lpcd ------------>			760 lpcd

(usa 625, Germany 200, Israel 170)

Energy	**1**	**2**	**3**	**4**
* National Policy Projects				
SO_2	1	0.72	0.44	0.68
	(1.61mt/y)	(1.16)	(.71)	(1.10)
No_x	1	1.17	1.37	2.11
	(0.93mt/y)	(1.09)	(1.27)	(1.96)
Ind. waste	1	1.5	2.2	3.4

Yeongheung-do Thermal Power Complex (12 units)

The World largest

Nuclear Power Plants

Nuclear Power Plants in Korea

			(GDP)
before IMF crisis	:	12 units in operation	(557.4 bil $ in 1996)
as of 2005	:	20 in op. (8 more built)	(546.9 bil $ in 2002)
by 2015	:	27 to be op(7 more in plan)	

Energy Saving Potential

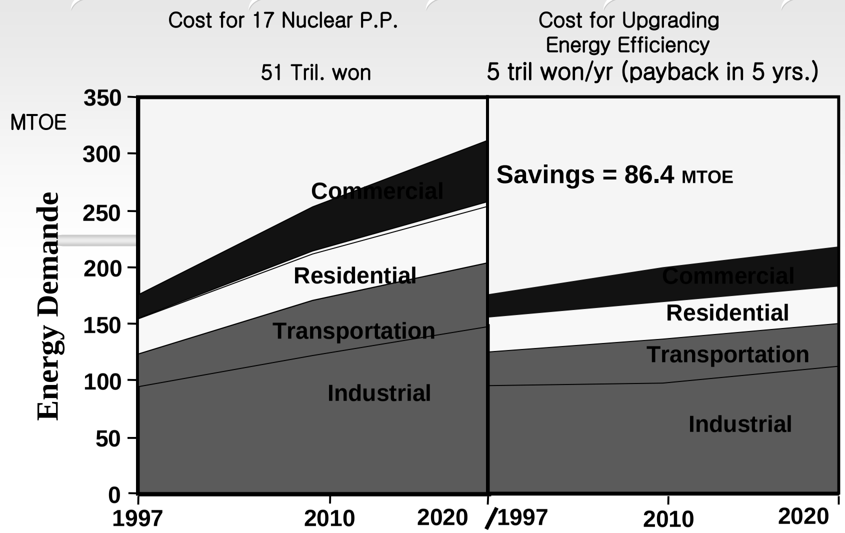
o Building Energy
accounts for ¼ of total energy
Germany: energy/unit area
< ½ of Korean apart.

o Motors
accounts for ¼ of total energy
only 1.2% are high-efficiency

o Multi-tap
can save 15% of energy

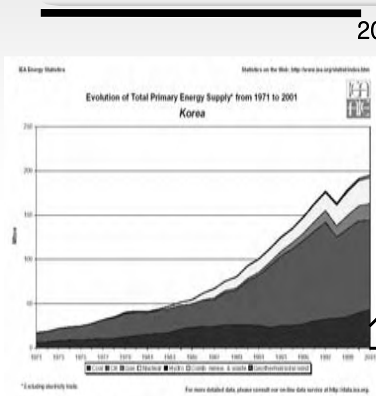
O All energy saving technologies
cost les than 1/3 of power plants

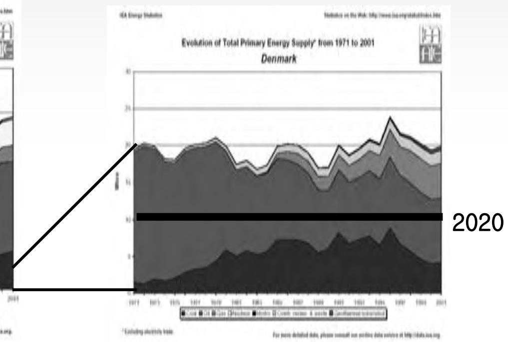
Energy Saving potential through efficiency



Energy Growth

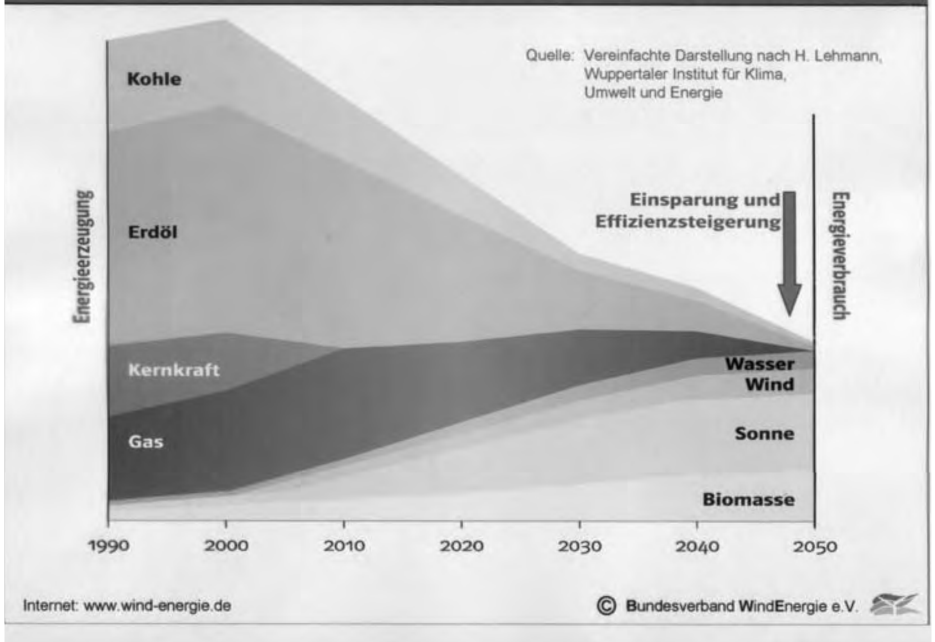
S. Korea : Denmark





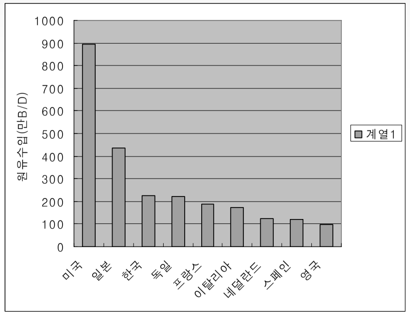
	S. Korea	Denmark
Population	47.6 mil	5.4 mil
Energy Use	200 MTOE	20 MTOE
Per Capita Income	14,162 $	38,590 $
Per Capita Energy Use	4.10 TOE	3.64 TOE

Germany's Energy Scenario 2050

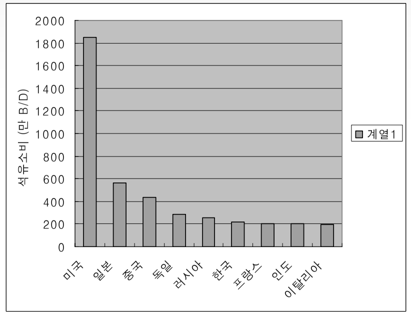


S. Korea's Position in Petroleum

crude oil import



oil consumption



Nuclear Wastes

⊙ Low·medium level wastes

Site	No. of reactors	capacity (drums)	stored (drums)	Saturation year
Kori	4	50,200	37,712	2014
Younggwang	6	23,300	10,602	2011
Uljin	4	17,400	12,030	2008
Weolseong	4	9,000	4,596	2009
Subtotal		99,900	59,940	
RI waste at NETEC		9,277	4,712*	2010

* As of 2003. 2

However,
the **6 tril wons**,
(6 bil dollars)
the fund collected from electricity fees,
for the purpose of
disposing the spent fuel
disappeared !!!

* Ministry of Science & Technology. 2004. 12.

Seoul–Busan High–Speed Train

To link the two cities in 2 hours

Design capacity : 300,000per/day

(current passengers: 70,000per/d)

* Huge deficit
  50 billion wons/yr

• Aggravates traffic to and fro small cities

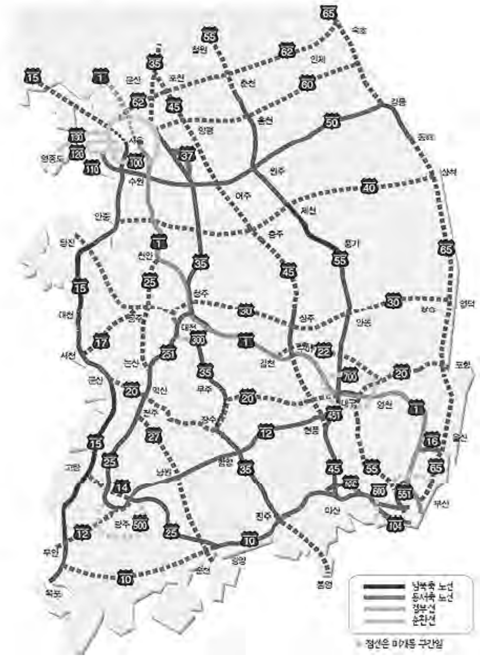
• Energy intensive
  Energy = f (speed^2)

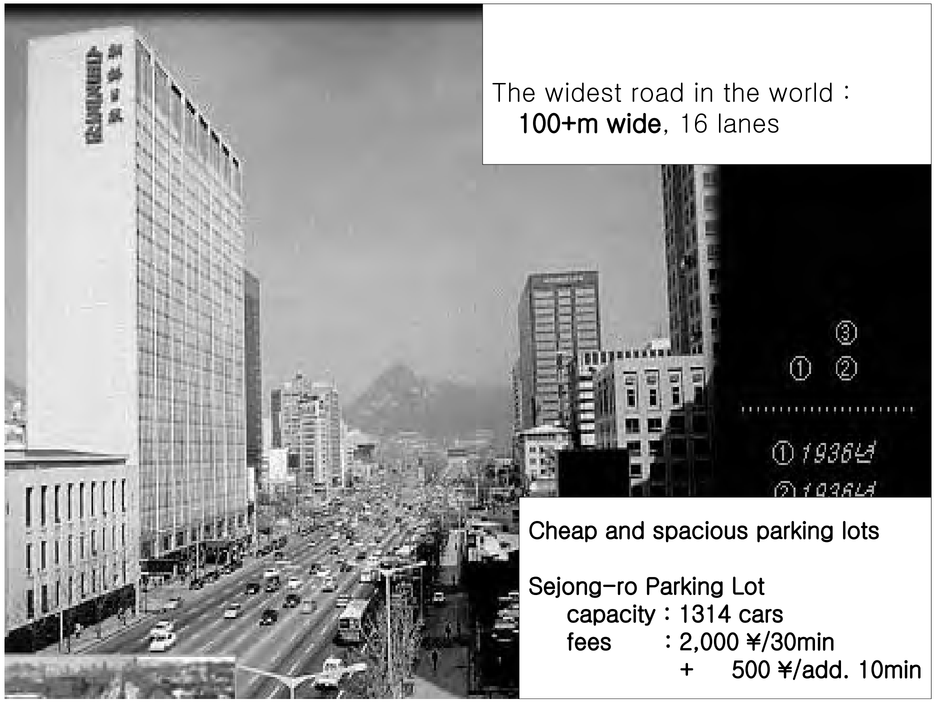
Highway Network Planning

'7x9' Network

to link all corners of country within half a day;

and to reach any highway from anywhere within 30 minutes



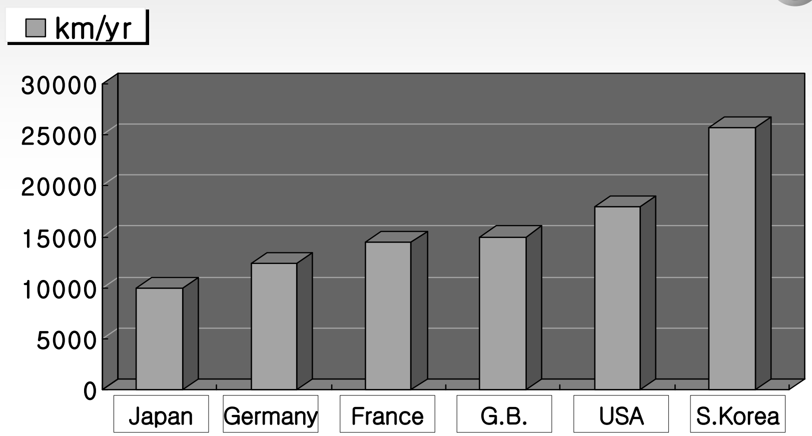


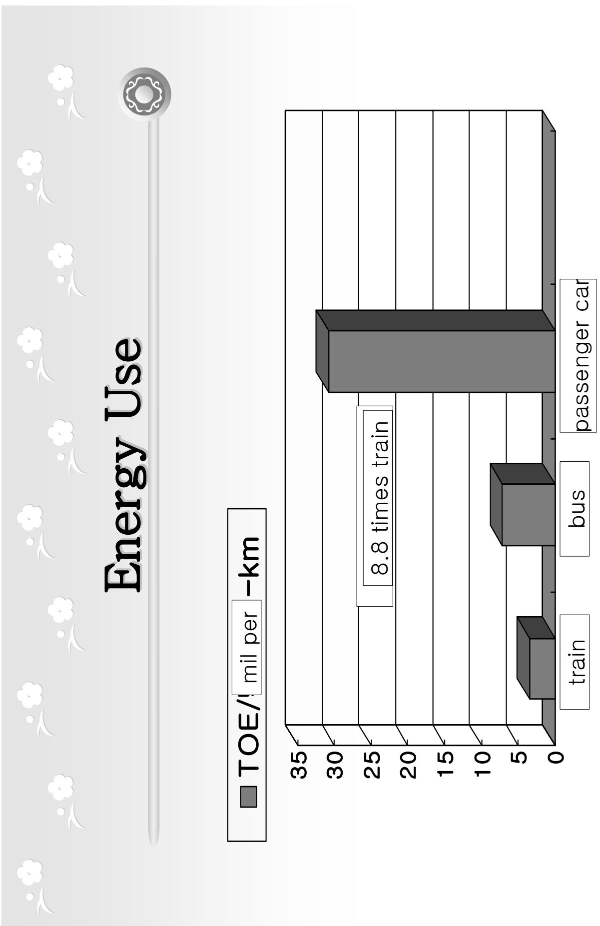
The widest road in the world :
100+m wide, 16 lanes

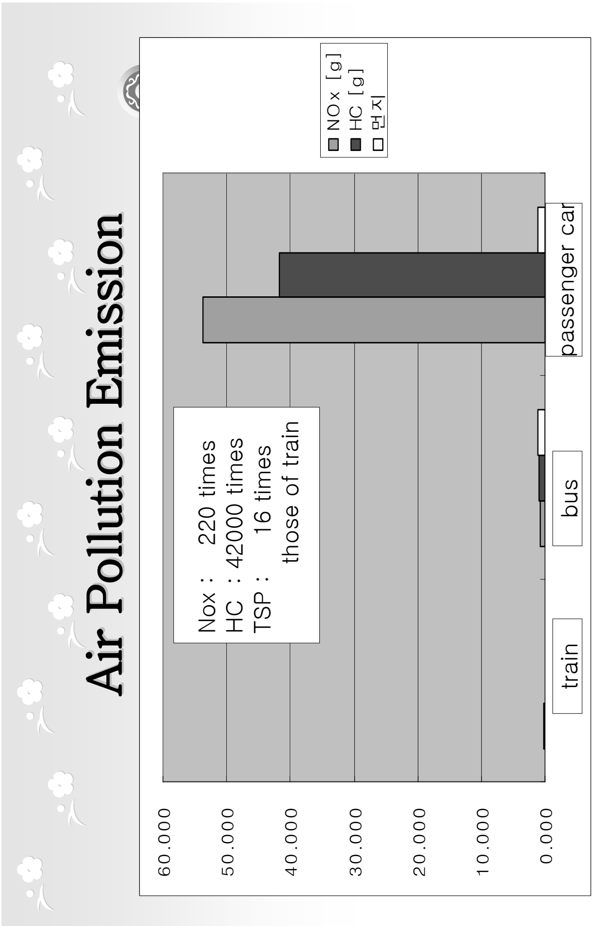
Cheap and spacious parking lots

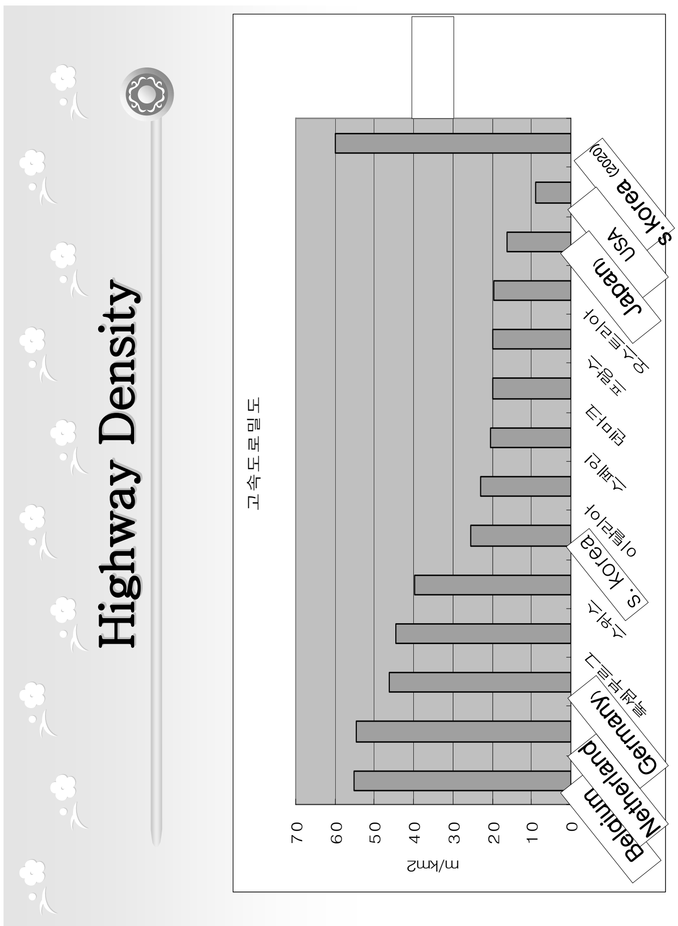
Sejong–ro Parking Lot
capacity : 1314 cars
fees : 2,000 ¥/30min
\+ 500 ¥/add. 10min

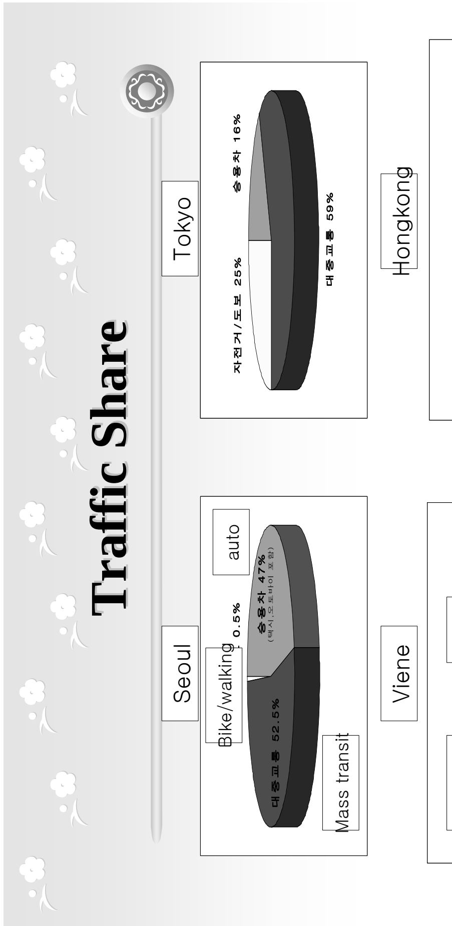
Automobile Mileage



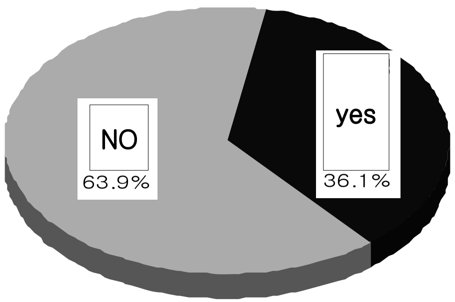

Energy Use
TOE/ mil per -km
8.8 times train
35
30
25
20
15
10
5
0
train
bus
passenger car


Air Pollution Emission
60.000
50.000
40.000
30.000
20.000
10.000
0.000
NOx [g]
HC [g]
먼지
Nox : 220 times
HC : 42000 times
TSP : 16 times
those of train
train
bus
passenger car
Emission from transporting 30 passengers 1km


Highway Density
고속도로밀도
m/km2
70
60
50
40
30
20
10
0
Belgium
Netherland
Germany
S. korea
Japan
USA
S.korea (2020)


Traffic Share
Seoul
Bike/walking
auto
Mass transit
대중교통 52.5%
승용차 47%
0.5%
Tokyo
자전거/도보 25%
승용차 16%
대중교통 59%
Viene
Bike/walking 25%
auto 13%
Mass transit 62%
Hongkong
자전거/도보 15%
승용차 40%
대중교통 45%

People's Opinion on Road Construction
(Min. of Env. 2003. 8)

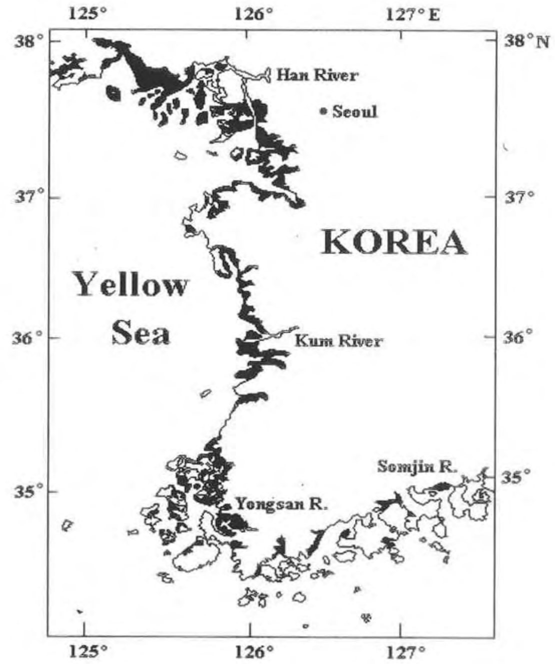


Distribution of

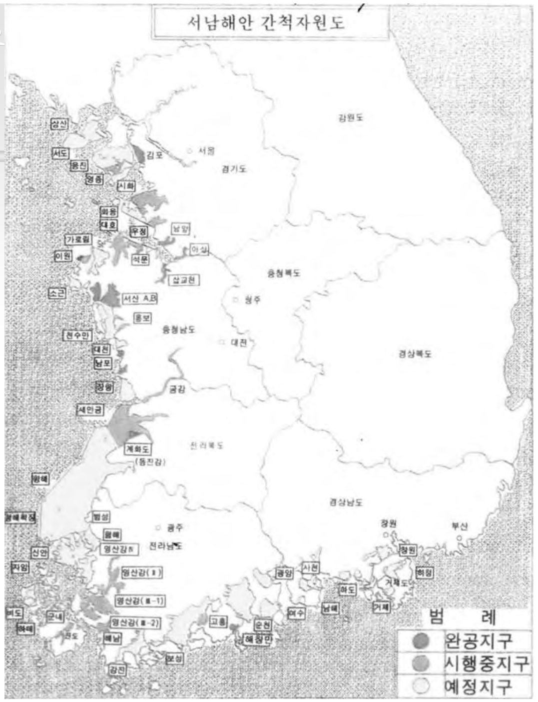
Tidal Flats on

The West and South

coast of KOREA



Reclamation Plan by government



Reclamation in the West Coast

to secure **farm land & industrial site**

Saemangeun **Project :**

the largest reclamation project in the world

28,000 ha farm lands with **6 tril. won**

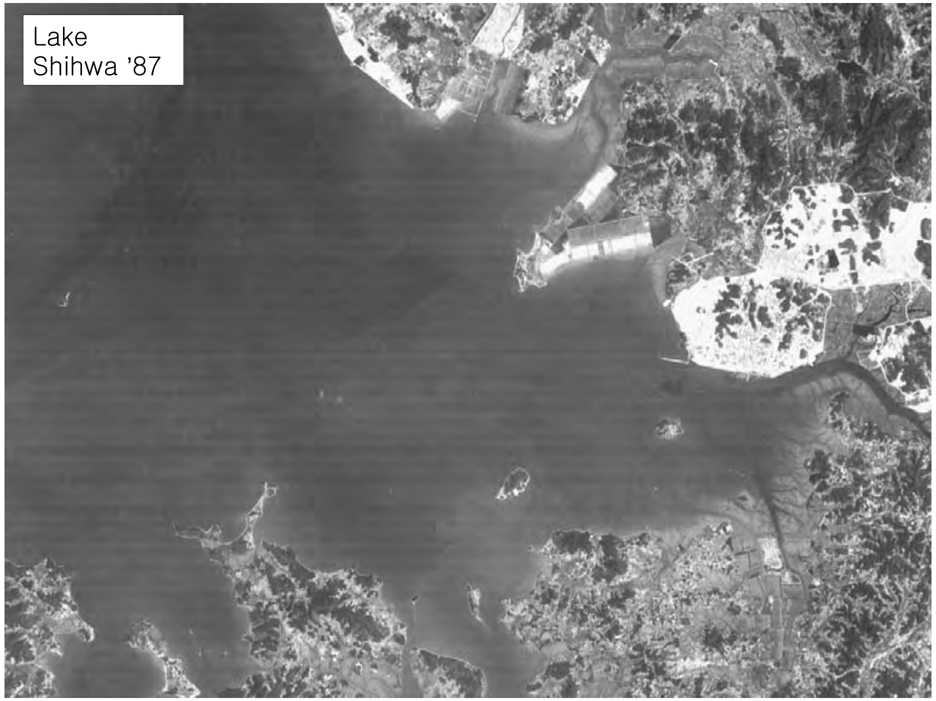
18,000 ha rice paddies

(However, 30,000 ha of rice paddies disappear each year.)

130,000 ha will be **laid idle**

because of surplus of rice

budget for agro-industrial development : 28 tril. won



Lake Shihwa warning Neglected !!!

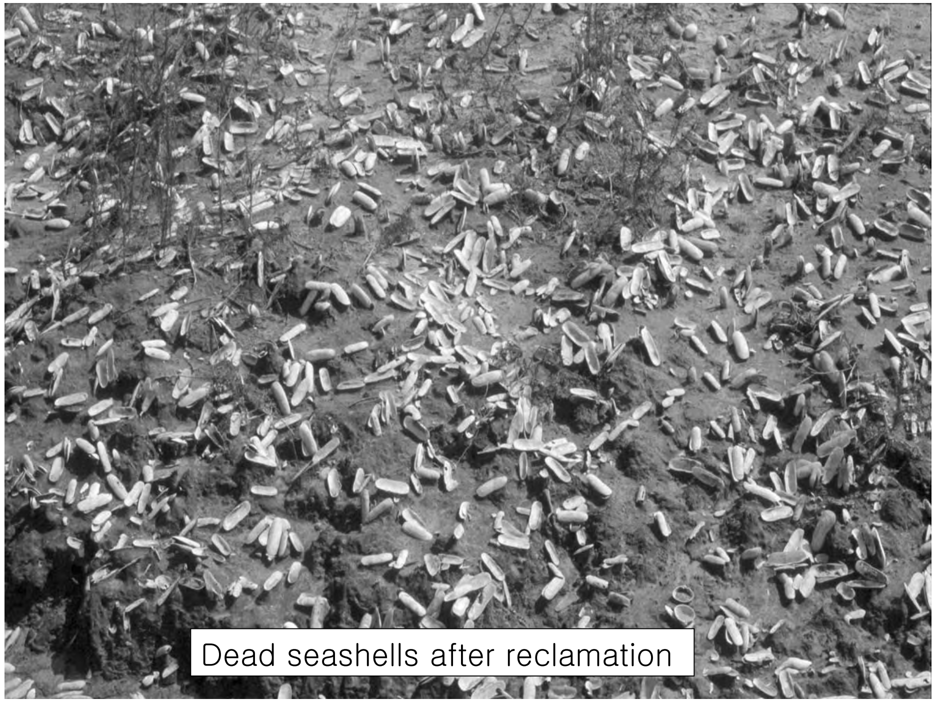
" The Lake Shihwa will be polluted to

a very dangerous level,

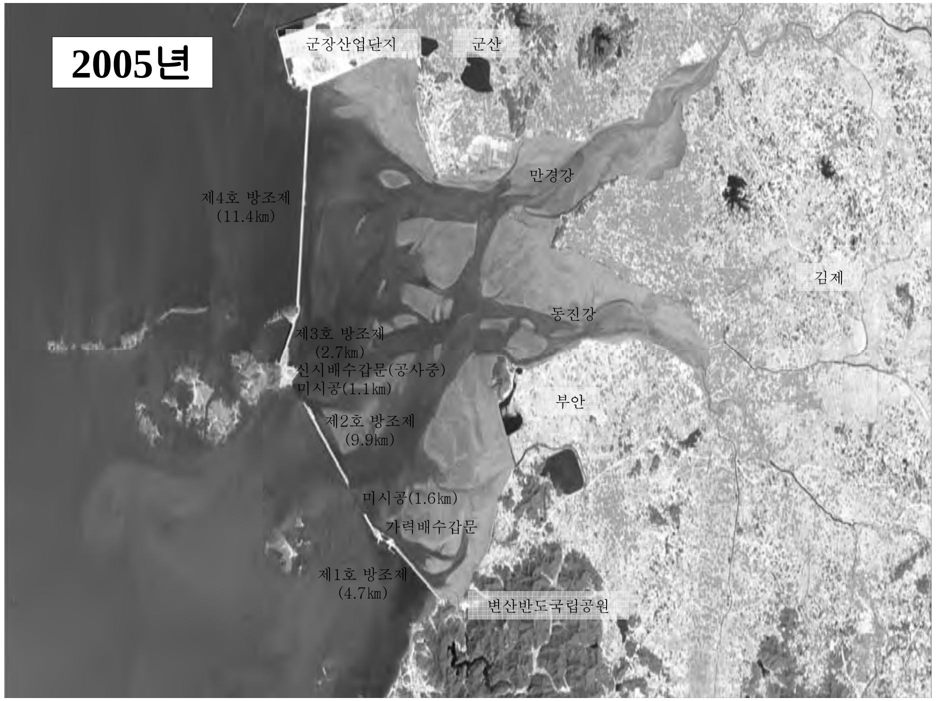
if reclamated as planned"

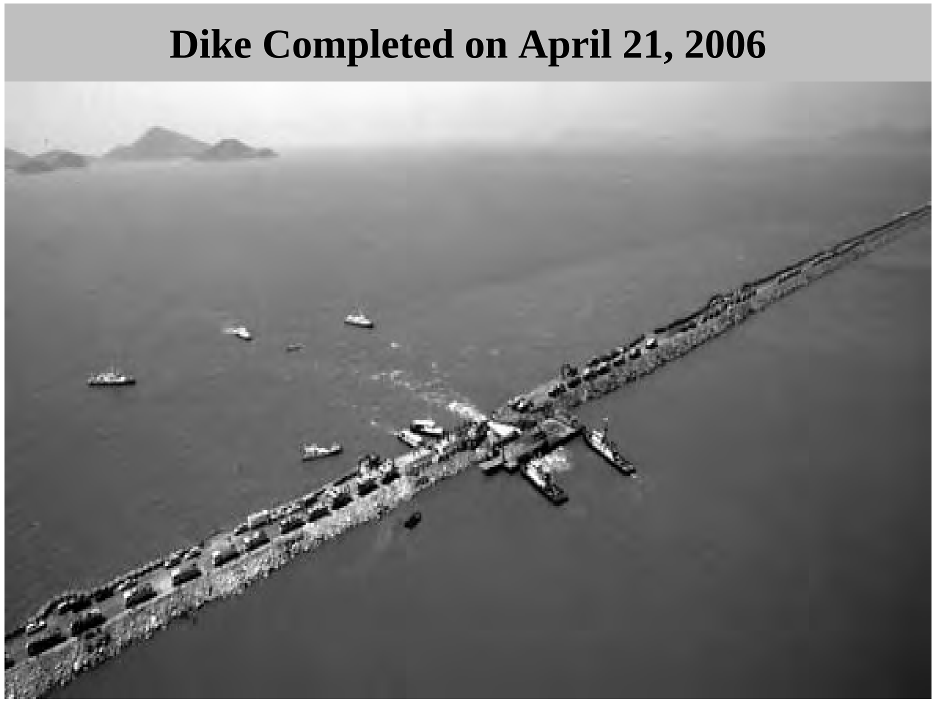
<A Study for the Management of Streams in Ansan City >, p. 116 (1991. 10)
(Jung Wk Kim)

Dead seashells after reclamation



Dead seashells after reclamation


2005년
군장산업단지
군산
만경강
제4호 방조제
(11.4㎞)
김제
동진강
제3호 방조제
(2.7㎞)
신시배수갑문(공사중)
미시공(1.1㎞)
부안
제2호 방조제
(9.9㎞)
미시공(1.6㎞)
가력배수갑문
제1호 방조제
(4.7㎞)
변산반도국립공원


Dike Completed on April 21, 2006


새만금 2006. 5. 4 (주용기 촬영)
김제 거전갯벌(죽은 동죽)


새만금 2006. 5. 4 (주용기 촬영)
김제 거전갯벌

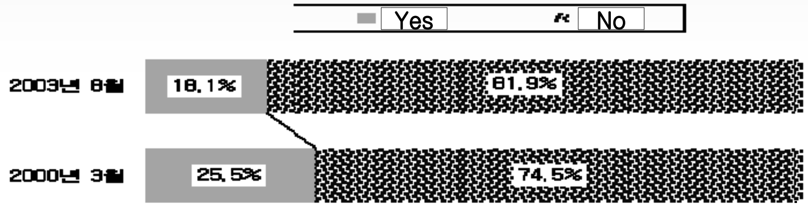

새만금 2006. 5. 4 (주용기 촬영)
김제 거전갯벌(죽은 빛조개)


새만금 2006. 5. 4 (주용기 촬영)
부안 문포 앞


새만금 2006. 5. 4 (주용기 촬영)
군산 어은리

새만금 2006. 8. 14, 15 (주용기 촬영)

Citizens' Opinion on the Reclamation of Mudflat



Multi-purpose Dam Project

Per-Capita Water Supply

: 535 lpcd from 14 dams --> 760 lpcd from 16 more dams

(1pcd : liter/capita-day) in 2012

Water Use in

USA	:	625 1pcd
Europe	:	200 ˝
<Germany	**:**	**200 >**
Asia	:	144 ˝
S. Amer.	:	130 ˝
Africa	:	67 ˝
<Israel	**:**	**170** (incl. agr. use)>

Water from **Dong-gang Dam** (1 tril. won) :
can be saved by **10 mil. eco toilets**(100 bil. won)

Water Savings potential

Water demand forecasted : 10.2 bil t/y (dom 73 + ind 29)
→ 13.6 bil t/y (dom 90 + ind 46) in 2020

o **by reducing leakage**
reduce leakage from 30% to 10% : 2 bil t can be saved

o by saving **domestic water use**
freeze at the present level : 1.7 bil t can be saved
efficiency toilet : 0.5 bil t can be saved
(13.5 – 16.5 liter → ~~8~~ → 9 liter)

o by recycling **industrial water**
freeze at the present level : 1.5 bil t can be saved

o by harvesting **rainwater**
can prevent flood also

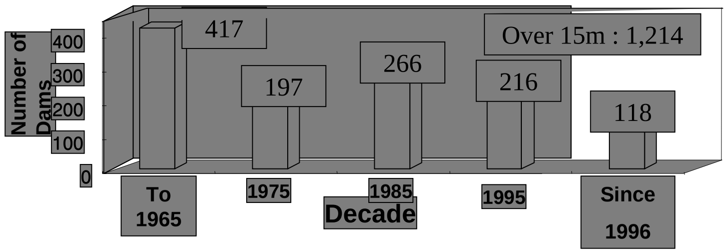
o **Total savings potential : 6+ bil tons/y**

Dam Constructed

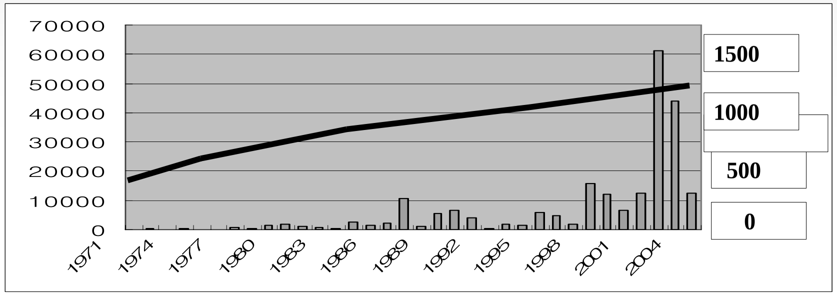
- Total number of dams constructed – 18,403
- Number of large dams – 1,214

defined by Int'l Committee of Large Dams

7th in the world



Dam Construction vs. Flood Damage



No. of Large Dams: No.7 in the world

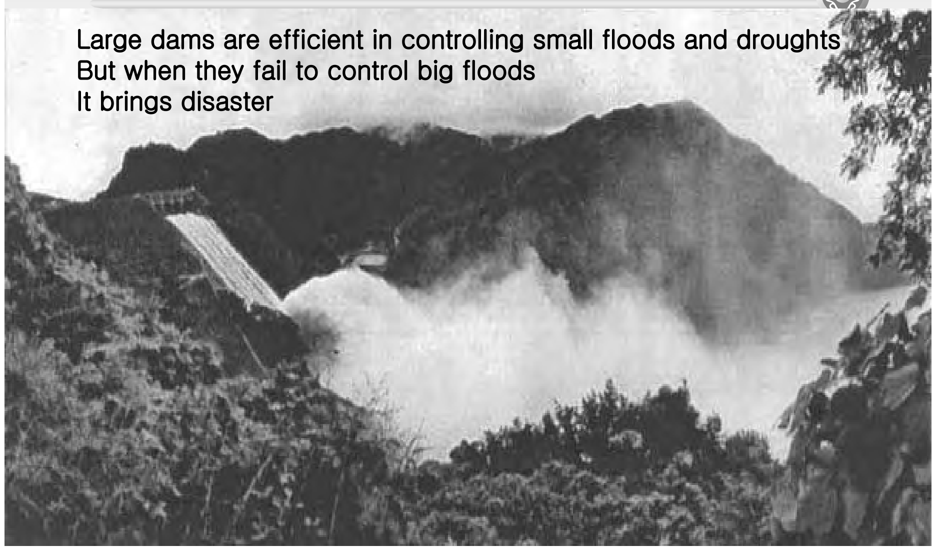
Many large dams have been built, but the flood damage has sharply increased

Source: Korea Statistics Yearbook

Multi-purpose dam sites

- Large dams are very effective in controlling small floods and drought,
- But when they fail in controlling big floods, it brings disaster.

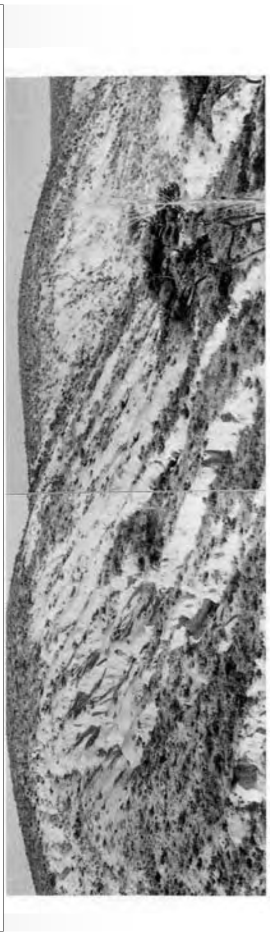
Soyang Dam discharge during flood



Reforestation Campaign in 1960's

40 years after

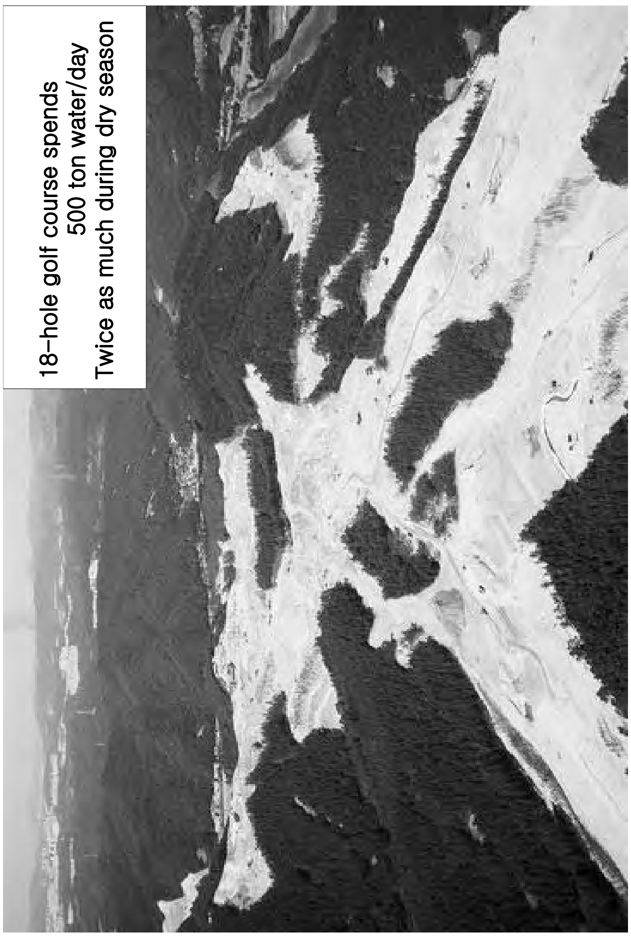
Korean Forest during 1950s



40 years after

Golf Course Construction Site

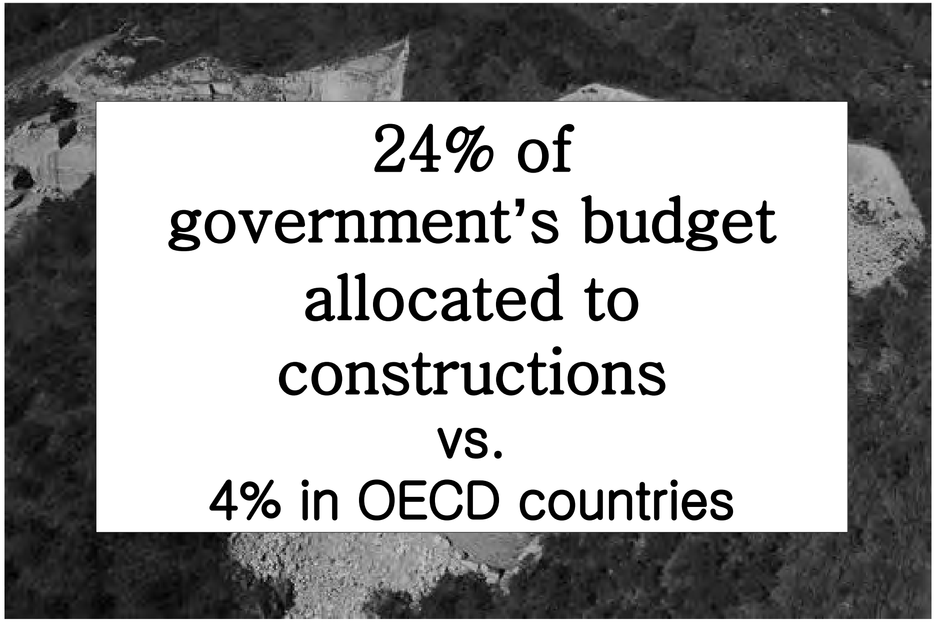
Road Construction Site



Golf Course Construction Site

Road Construction Site

Quarry



24% of government's budget allocated to constructions
vs.
4% in OECD countries

Quarry

Environmental Sustainability Index

ESI (Environmental Sustainability Index) by World Economic Forum

2001 : 95th among 122 countries

2002 : 136th among 142 countries

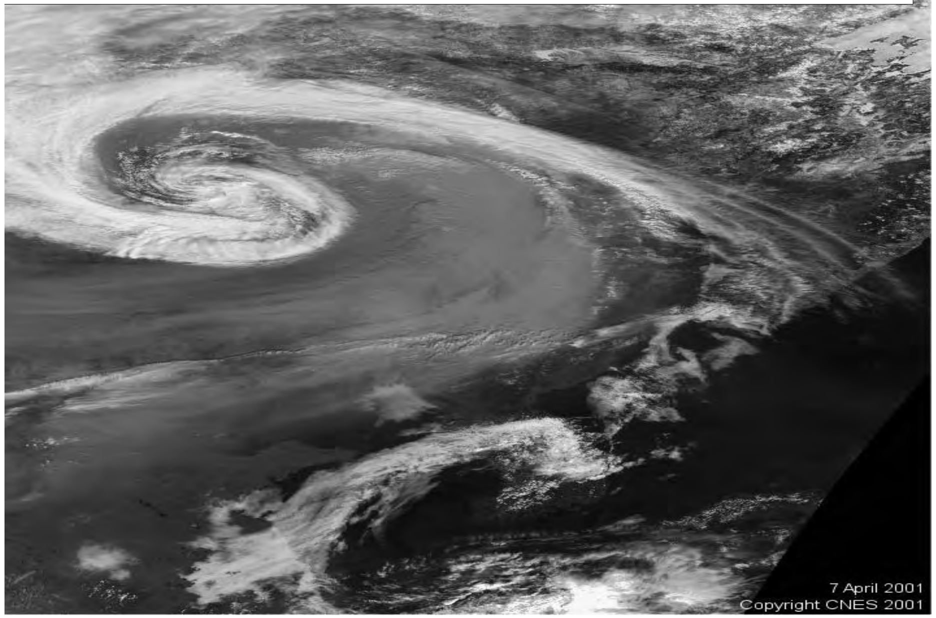
2005 : 122th among 146 countries
(146th in pollution loading)

ESIs of Other Asian Countries

ESI (Environmental Sustainability Index)
by WEF (World Economic Forum) (2005)

Country	ESI rank (among 146 countries)	Country	ESI rank (among 146 countries)
Japan	30	Bangladesh	114
Laos	52	S. Korea	122
Cambodia	68	Philippines	125
Mongolia	71	Vietnam	127
Thailand	73	China	133
Indonesia	75	Taiwan	145
India	101	N. Korea	146

Yellow Dust Storm over Northeast Asia



Seoul, 2006. 4. 9.

Yellow Dust Storm

The frequency is increasing each year.

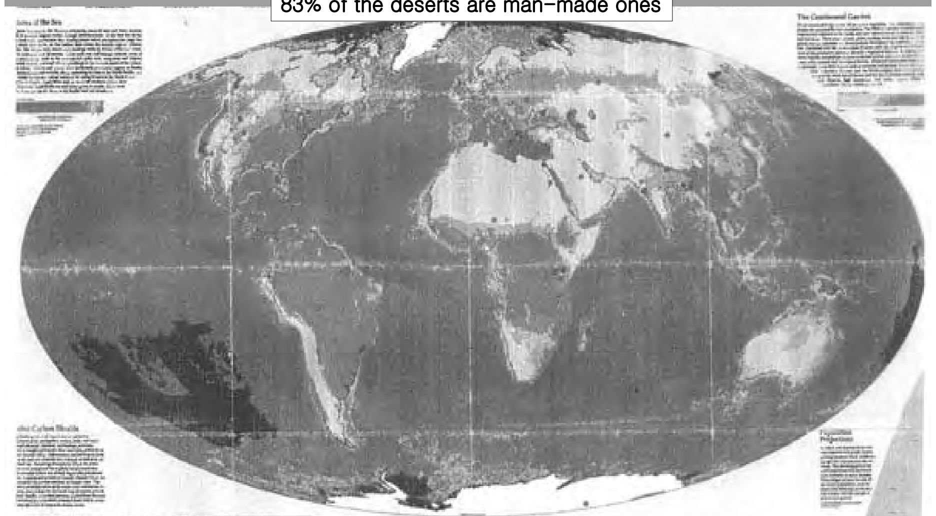
historically	: once in several years
1960s – '70s	: <3 days/yr
1980s	: 3.9 days
1990s	: 7.7 days
2000 –	: **17 days**

The intensity is increasing each year also.

PM10 in Seoul in 2002	: 2778.2 microgram/m^3
2006	: 2770 "
Standard	: 150 "

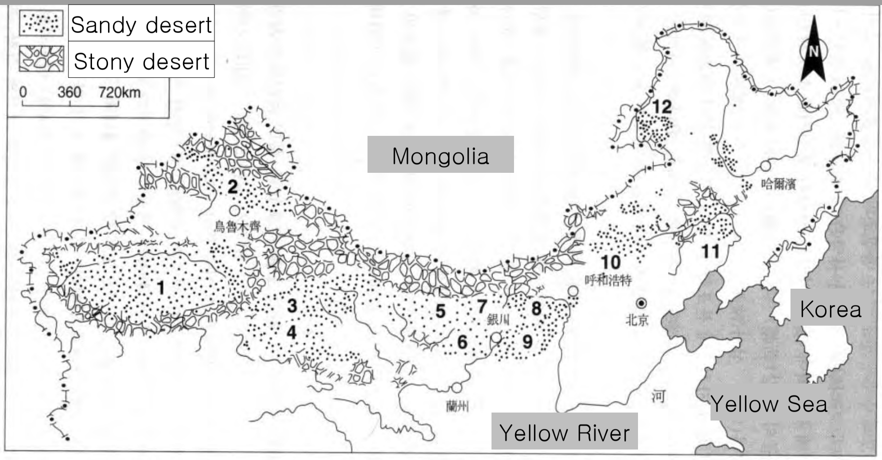
1/3 of the world is desert or semi-desert

83% of the deserts are man-made ones



More than half of China is desert or semi-desert.

Desertification in Northern China



① 塔克拉瑪干沙漠, ② 古爾班通古特沙漠, ③ 庫姆塔格沙漠, ④ 柴達木盆地沙漠, ⑤ 巴丹吉林沙漠, ⑥ 騰格里沙漠, ⑦ 烏蘭布和沙漠, ⑧ 庫布齊沙漠, ⑨ 毛烏素沙地, ⑩ 渾善達克沙地, ⑪ 科爾沁沙地, ⑫ 呼倫貝爾沙地

More than 1/2 of the Yellow River Basin used to be thick forest until 2000 years ago,

but now less than 5% of the region remains as poor forest.

Shunze(荀子, 彊國篇)

(during warring states, 2,200 years ago)

Upon entering CHIN(秦),

Forests were thick,

Valleys were beautiful,

Resources were plentiful.

(富國篇)

Furrows are full of grains,

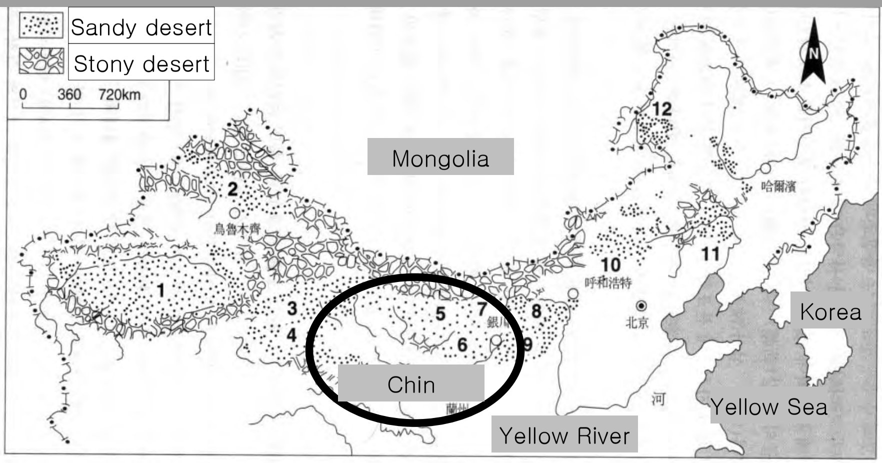
Fishes swim in swarms,

Birds fly like clouds,

Insects and all living creatures fill the universe,

Foods are as much as we want.

Desertification in Northern China

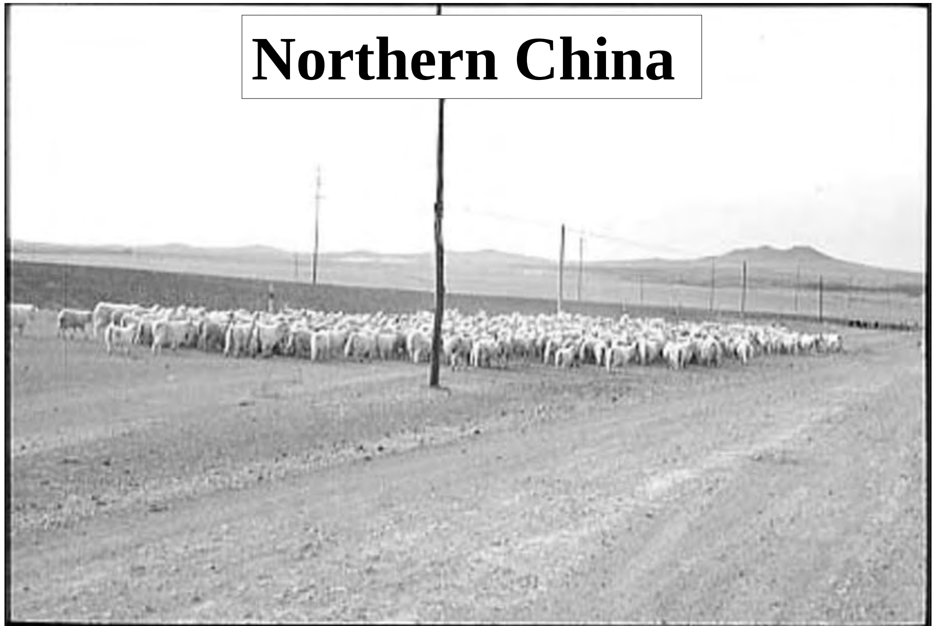


① 塔克拉瑪干沙漠, ② 古爾班通古特沙漠, ③ 庫姆塔格沙漠, ④ 柴達木盆地沙漠, ⑤ 巴丹吉林沙漠, ⑥ 騰格里沙漠, ⑦ 烏蘭布和沙漠, ⑧ 庫布齊沙漠, ⑨ 毛烏素沙地, ⑩ 渾善達克沙地, ⑪ 科爾沁沙地, ⑫ 呼倫貝爾沙地

More than 1/2 of the Yellow River Basin used to be thick forest until 2000 years ago,

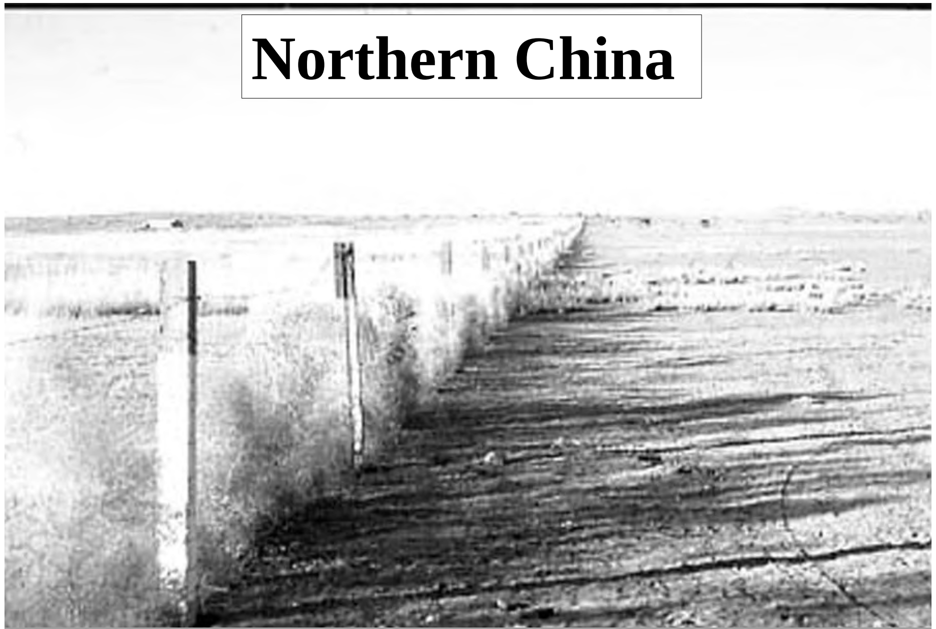
but now less than 5% of the region remains as poor forest.

Northern China



Over-grazing is the major cause of desertification in Northern China.

Northern China



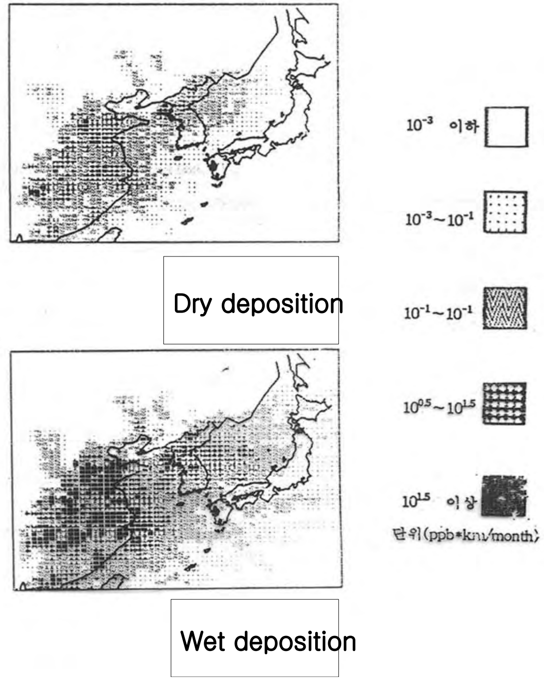
Over-grazing is the major cause of desertification in Northern China.

Acid Deposition from China

Japan: more than 50% from China

Korea : 20 – 50% from China

LA : ¼ of PM from China



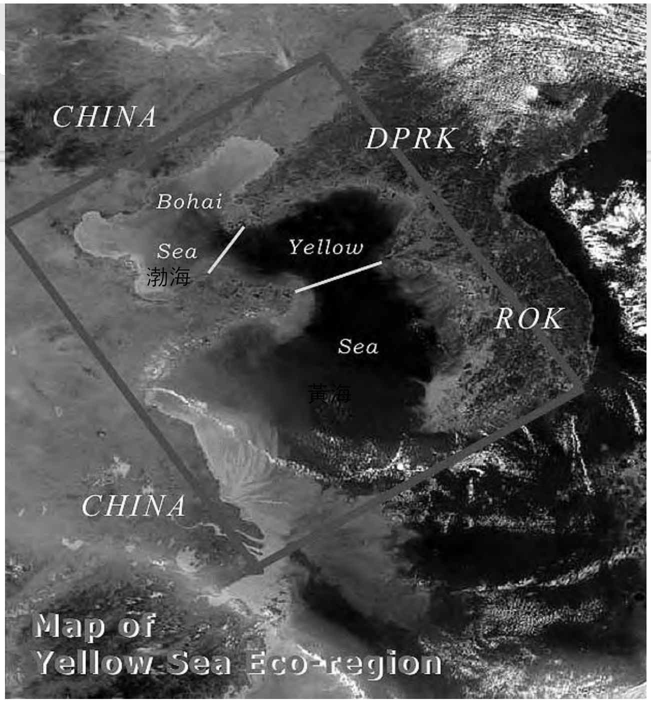
China's
low-quality coal

contains

Fluorides
Mercury
Arsenic
Cadmium
Lead

etc.

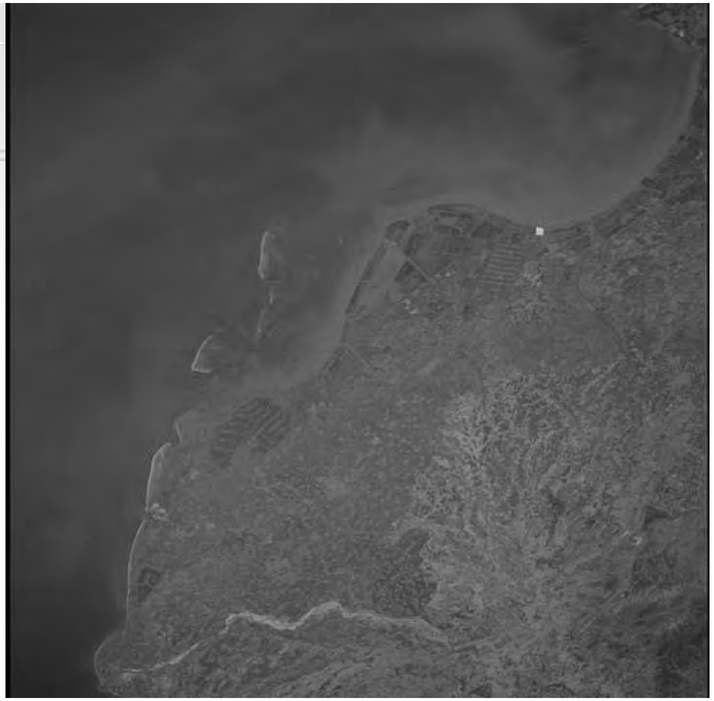
. More than 40 million people suffer from fluorosis.
. Affected children's IQs are 10 points lower.



Pollution in Yellow Sea is clearly shown

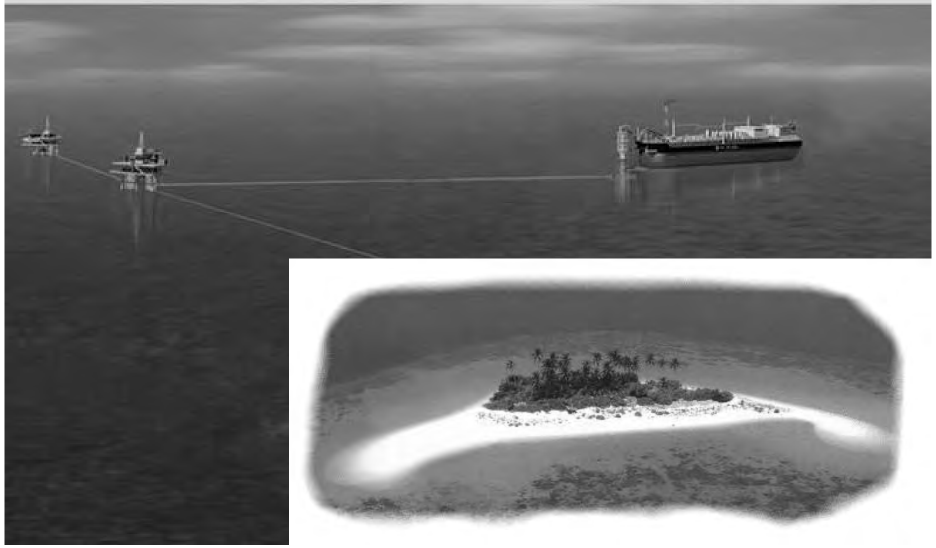
Bohai Sea

(satellite image)



Oil well in Bohai Sea

The water is not blue



Composition of Acid Rain(μ eq/1)

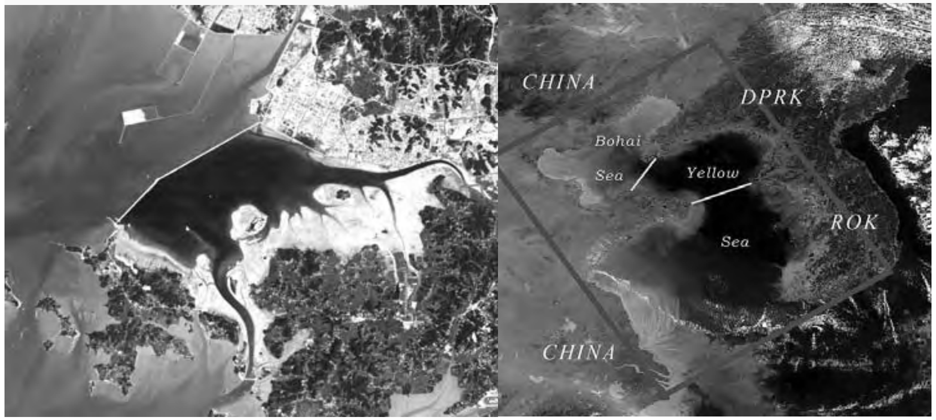
Location		pH	SO_4^{--}	NO_3^-	Cl^-	NH_4^+	Ca^{++}	Mg^{++}	Na^+	K^+	Period
	(1 eq =		48 g	62	35.5	18	20	12	23	39)	
Not Polluted											
Lake Tahoe	Snow	5.6	33	2	6	0	0	17	26	15	'58.11.20
Menlo Park, CA	Rain	6.4	15	3	23		60	58	0	0	'58. 1.9
"	Bulk	5.5	158	0	479		40	100	409	0	'57 - 59
	(Rain + Snow + Dry Deposition)										
Polluted											
<N. Amer.>											
Pasadena, CA	Wet	4.06	60	75	29	33	10	7	25	2	'78. ave.
Muskoka, Ont.	W.	[illegible]	67	30	9	31	36	10	17	4	'79. "
NY, NY	"	3.92	125	39	43	11	16	13	36	2	'79. "
Chester, NJ	"	[illegible].10	73	33	17	14	6	5	18	2	'79. "
Florida	"	4.53	43	14	28	7	21	10	19	5	'80. "
Hovland	"	4.67	39	21	26	37	20	11	6	3	'82. "
Itasca	"	5.00	32	20	47	34	35	19	9	4	'82. "
Tewaukin	"	5.27	36	26	50	48	53	23	12	6	'82. "
<China>											
Beijing(北京)	"		$\boxed{155}$	40		$\boxed{163}$	152				'85 - 86
Changchun(長春)	"		$\boxed{157}$	21		$\boxed{61}$	257				"
Jinzhou(錦州)	"		$\boxed{259}$	49		$\boxed{123}$	341				"
Shenyang(瀋陽)	"		$\boxed{398}$	[illegible]		$\boxed{99}$	305				"
Shanghai(上海)	"		$\boxed{153}$	13		$\boxed{76}$	104				"
Hangzhou(杭州)	"		$\boxed{.12}$	14		$\boxed{68}$	60				"
Guilin(桂林)	"		$\boxed{107}$	20		$\boxed{50}$	67				"
Chongqing(重慶)	"		$\boxed{327}$	28		$\boxed{151}$	128				"
Guangzhou(廣州)	"		$\boxed{283}$	66		$\boxed{228}$	181				"

- **Rain in China is very high in ammonia because of manure applied on agricultural farms.**
- **When the flush toilets wash the manure to the Yellow Sea, the sea cannot carry it.**

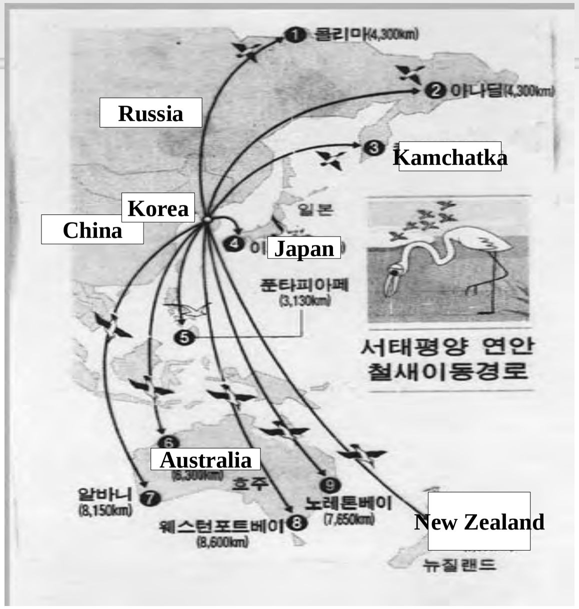
If China discharges the manure to the Yellow Sea

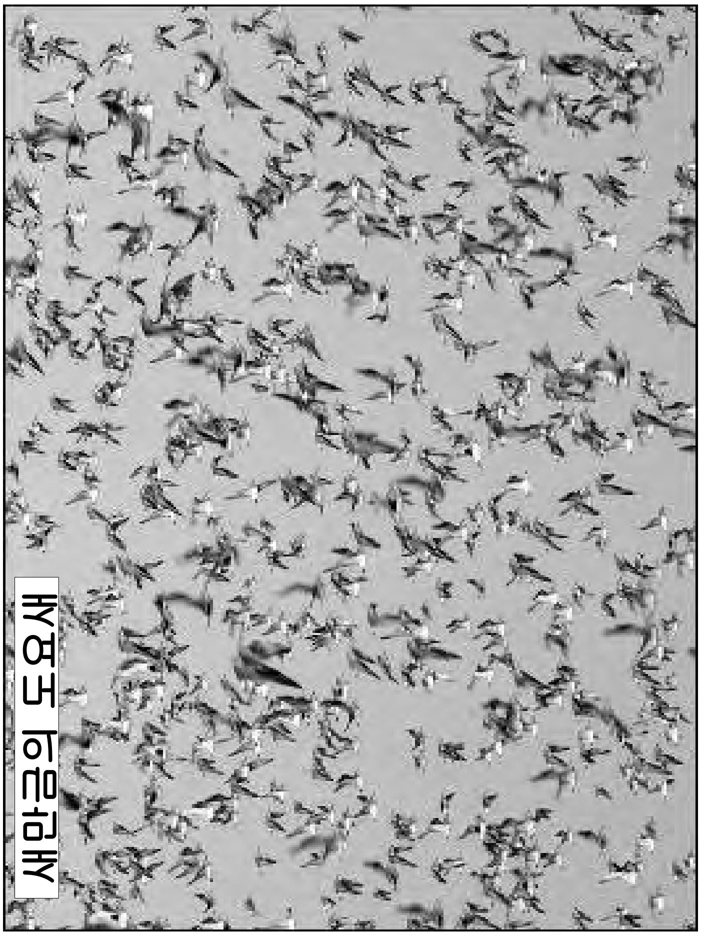
BOD loading to Shihwa : 50 g/m^3-yr

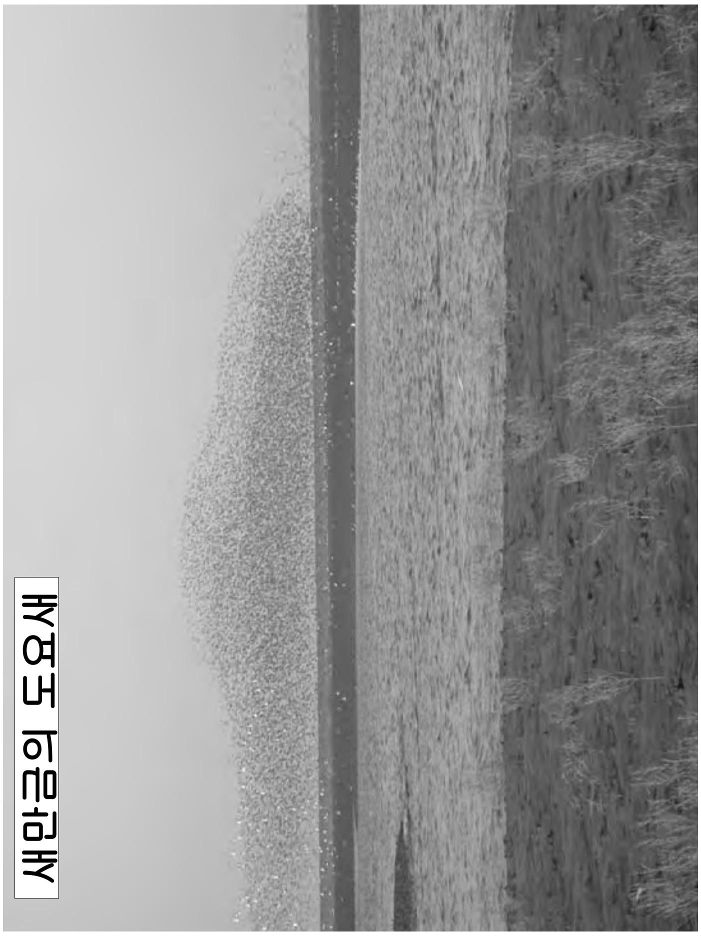
BOD loading to Yellow Sea: 800 g/m^3-yr

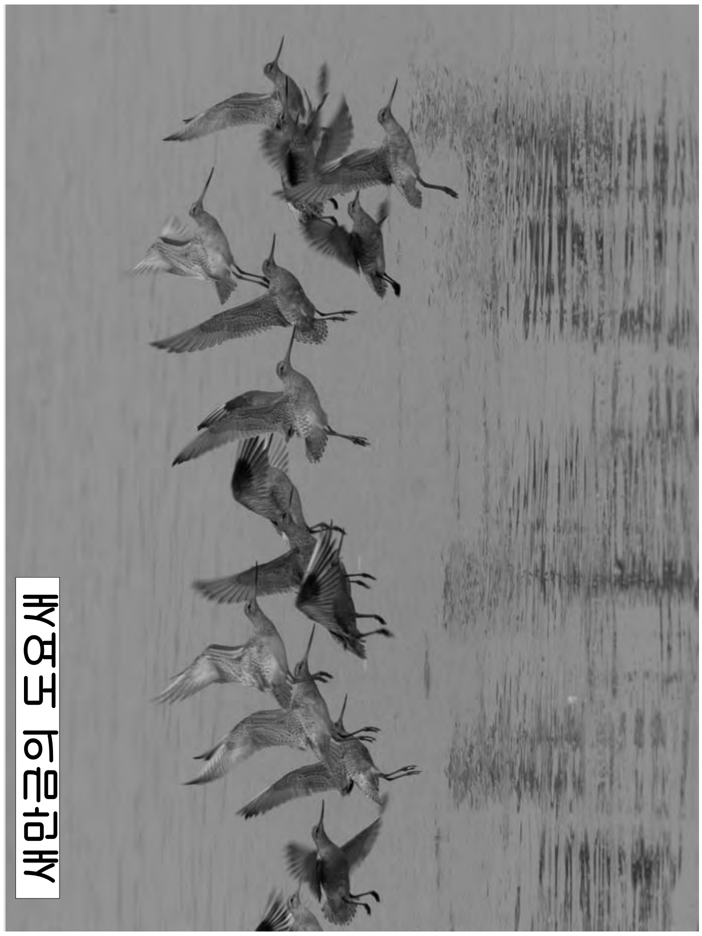


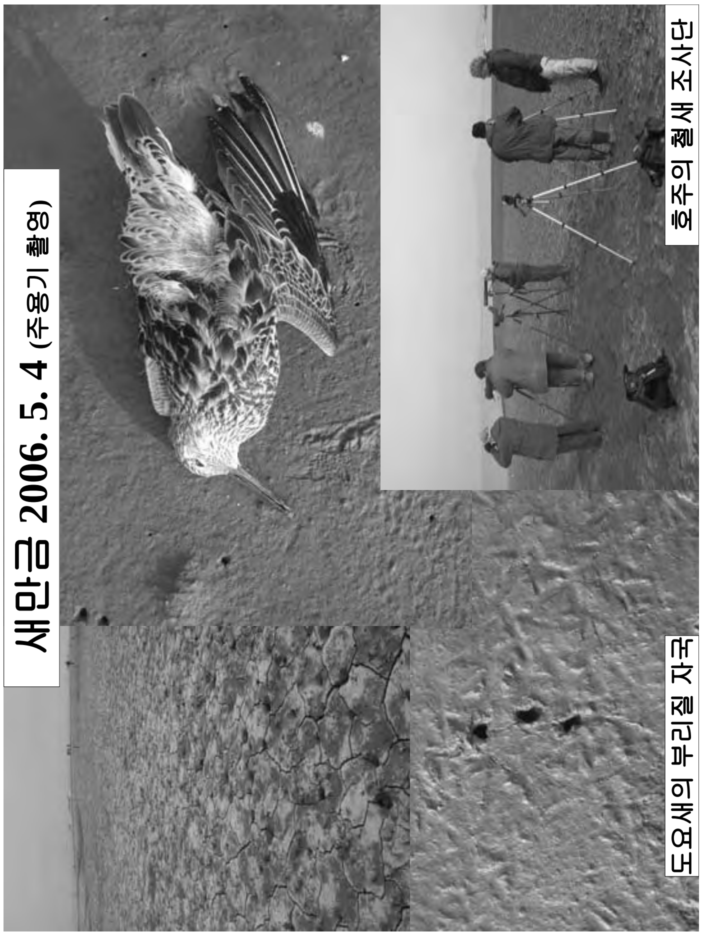
Birds' Flyways in the Western Pacific

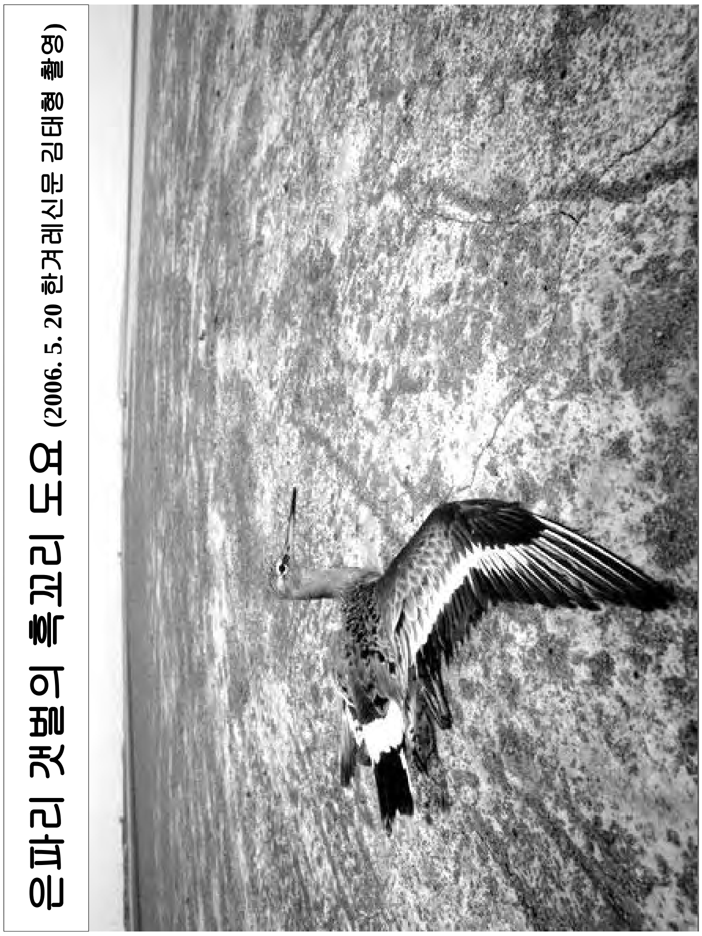



새만금의 도요새


새만금의 도요새


새만금의 도요새


새만금 2006. 5. 4 (주용기 촬영)
호주의 철새 조사단
도요새의 부리질 자국


은파리 갯벌의 흑꼬리 도요 (2006. 5. 20 한겨레신문 김태형 촬영)

Human Abuse　　Animal Abuse

Human Abuse　　Animal Abuse

Epidemics from animal and nature abuse

From disturbing deep ecosystem

AIDS, SARS

From abusing animal

Bird Flu, Foot & Mouth Disease,
Pig Cholera

From feeding meat to grass-eating animal

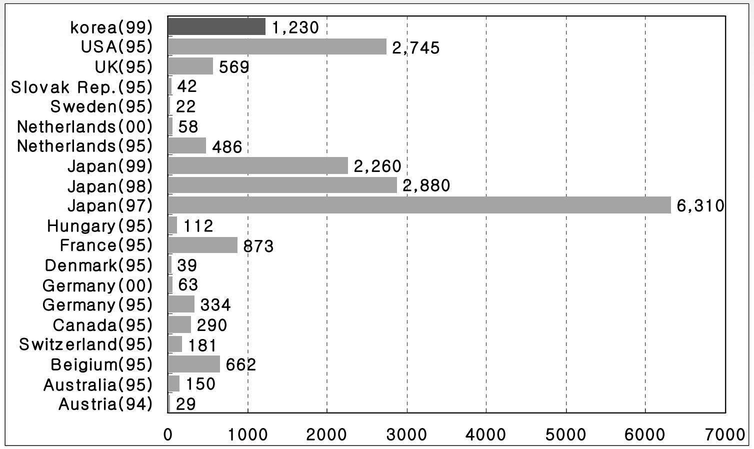
Mad-cow Disease(from protein “prion”)
O-157

From excessive use of antibiotics

Super Bacteria

Dioxin Emission by countries (g-TEQ/yr)

(data from Prof. Lee Dong Soo)



Viktor Yushchenko
(Ukraine)

Dioxin Poisoning

Chloracne

for Sustainability

o Energy : Renewable Energy

o Material : should be Recycled

o Environmental Burdens:

should remain within earth's

Carrying Capacity

Environmental Landuse Planning

- Conservation goal should be set on

  Forests,
  Tidal Mudflats,
  Farmlands

- Conservation goal should be set on

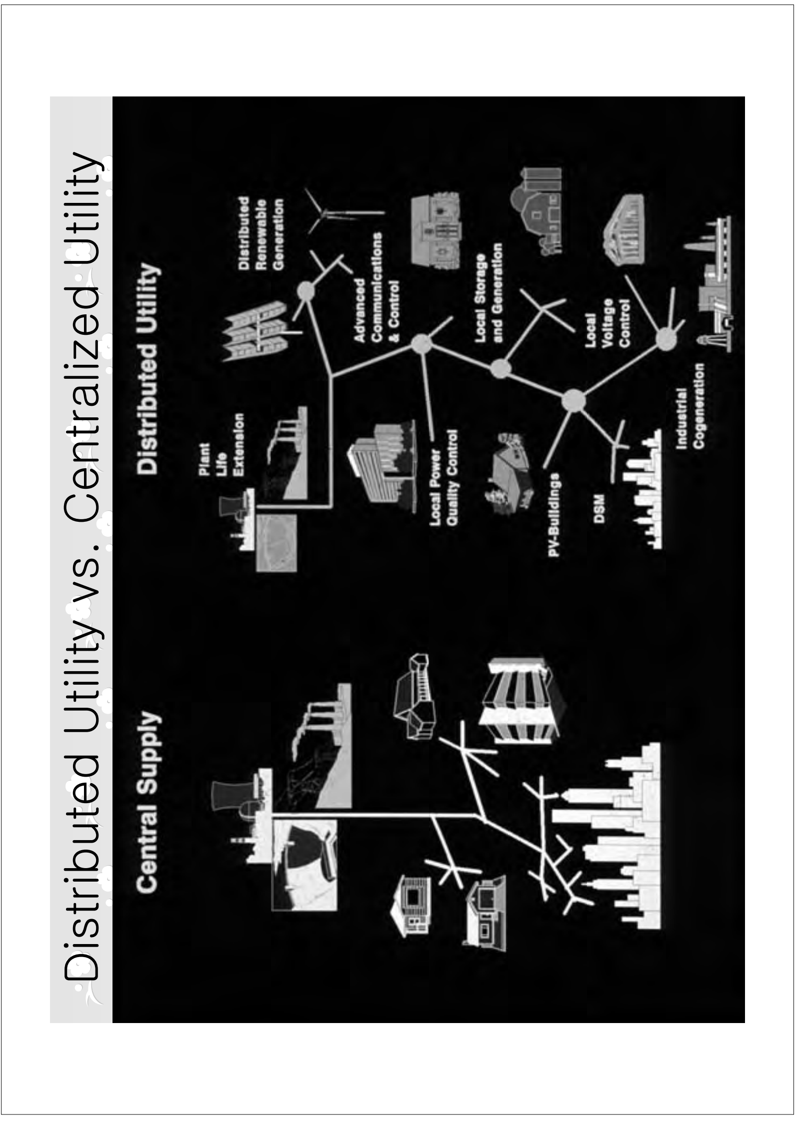
  urban and industrial development;
  pollution emission

- Each local community should be built as an **ecological unit**

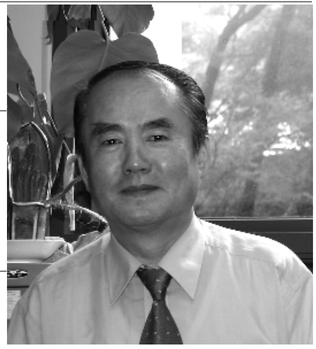
Ecological Communities

1. Each as an Ecological Unit
   Local climate, geography & culture should be respected
   1) distributed energy system based on renewable energy
   2) material recycle society
      food, water, solid wastes
   3) environmentally-friendly transportation
      railroads between cities
      energy-efficient transportation within cities

   *Urban size should be smaller (<200,000~300,000)
   *Luxuries should be imported at minimum,
   necessities should be produced within at maximum
2. Recycle and Coop. between communities
   1) foods : **CSA(Community-Supported Agriculture)**
   2) wastes
   3) daily commodities
3. Ecological Production-Consumption System
   1) food production - consumption
   2) industrial production - consumption
   3) consumption


Distributed Utility vs. Centralized Utility
Central Supply
Distributed Utility
Plant Life Extension
Distributed Renewable Generation
Advanced Communications & Control
Local Power Quality Control
Local Storage and Generation
PV-Buildings
Local Voltage Control
DSM
Industrial Cogeneration

Profile



Name Jung Wk Kim, Ph.D.
Affiliation Professor, Graduate School of Environmental Studies, Seoul National University

Education:

1968	Bachelor of Engineering, Seoul National University
1974	Master of Science, University of Rhode Island
1977	Ph.D., The University of Texas at Austin

Professional Career:

1977-1982	Senior Researcher, Korea Institute of Science & Technology
2001	Fulbright Scholar at University of Delaware
2002-2003	Dean of Graduate School of Environmental Studies
1982-	Professor, Seoul National University

Committee/ Boards:

- Adviser, Environment and Pollution Research Group
- Co-chair, Korean Christian Environmental Movement Solidarity for Integrity of Creation
- Co-chair, Korea Zero Waste Movement Network
- Secretary, Asia-Pacific Environmental Council
- Member, Atomic Energy Commission

Research Fields/ Interests:

- Air Quality Management and Modeling
- Water Quality Management and Modeling
- Environmental Impact Assessment

Selected Publications:

- Kim JW, “Environmental Awareness and Movement in the Republic of Korea”, Proc. Hokkaido University-Seoul National University Joint Symposium on Perspective of University Reform in the 21st Century, Hokkaido University, (2002).
- Kim JW, “Resource Management and Environmental Conservation toward Sustainability”, Journal of Integrative Studies, 16(1), 9-43(2003).
- Kim JW, “Greenhouse Gas Reduction Potential for South Korea”, J. Environ. Studies, 41, 99-120(2003).
- Kim JW, “Korea, Land of Environmental Risk”, Rethinking the "Modern" in the globalizing world, 55-72(2005).
- Kim JW, “Social Environmental Education toward Sustainable Development in the East Asian Region”, Proc. International Conference on Education for Sustainable Development, Tokyo, 1-8(2005).
- S.H.Jin & Kim JW, “A Study on the State of Local Air Pollution in North Korea: Focusing on Rural, Urban and Industrial Area,” J. Environmental Policy, 13(2), 117-141

Environmental Problems and Strategies in China

Yanqing Wu, Ph.D.
Professor, School of Environmental Science and Engineering,
Shanghai Jiao Tong University

Abstract

The rapid economic growth of developed nations and developing nations in world is bringing welfare and higher living standard to human being. The economic growth, however, is accompanied by natural resources depletion, ecological degradation, environmental pollution, biodiversity loss. As a member of ecological system, ecological and environmental problems are influencing health and sustainable development of human being.

In recent two decades, China economy is rapidly growing as a biggest developing country and improve living standard of most Chinese peoples. However, environmental problems such as atmosphere pollution, water pollution, ecological degradation, ocean pollution, soil pollution, groundwater pollution, and so on, are influencing sustainable development of China. In order to development economy and improve environment, China government is enhancing environmental management. In this paper, based on environmental evolvement process of China within 15 years, author have analyzed the environmental problems of China and proposed environmental strategies. The environmental strategies include (1) to change in living pattern and production mode, to change traditional natural opinion about human being as center of natural world, and to set up the development opinion of harmoniousness between human and nature; (2) to construct “ecological city” and “ecological industry”, to sparkplug a close-loop economic system; (3) to environmental laws and enhance environmental management, EGDP evaluation index instead of GDP index; (4) to enhance environmental science research and increase the investments of environmental science research and polluted environment remediation; (5) to educate the common people to enhance environmental civil consciousness and become widely participant; (6) to set up mechanism and forum globe environment assessment and increase international cooperation in environmental field.

Environmental Problems and Strategies in China

Yanqing Wu

School of Environmental Science and Engineering,

Shanghai Jiao Tong University, Shanghai 200240, China

for presentation at
International Symposium on
Strategies to Achieve a Closed-loop Economy in Asia

Osaka University, Japan
22 November 2006

Outline of this talk

1) Introduction: The Relationship among Environment, Economy and Society

2) Environmental Problems in China

3) Strategies of Solving Environmental Problems

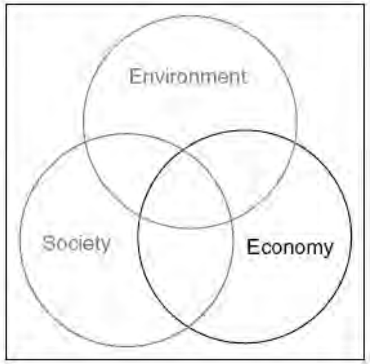
Introduction: The Relationship among Environment, Economy and Society

- The rapid economic growth of developed nations and developing nations in the world is bringing welfare and higher living standard to human being. The economic growth, however, is accompanied by natural resources depletion, ecological degradation, environmental pollution, biodiversity loss. Now ecological and environmental problems are influencing human's health and sustainable development.

Introduction: The Relationship among Environment, Economy and Society

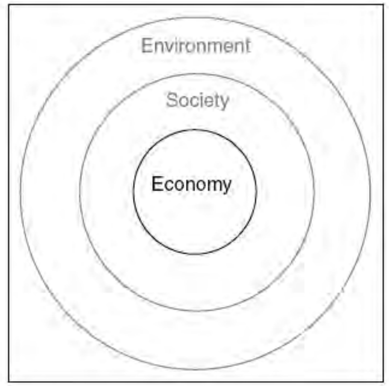
- **Harmonious Society is basic for human life.**
- **Harmonious Society needs economy health development under friendly environment.**
- **Sustainable development requires harmonious relationship among environment, economy and society.**

ICLEI(1996), du Plessis (2000), and Barton (2000) proposed the model of relationship among economy, society and environment as the follows:



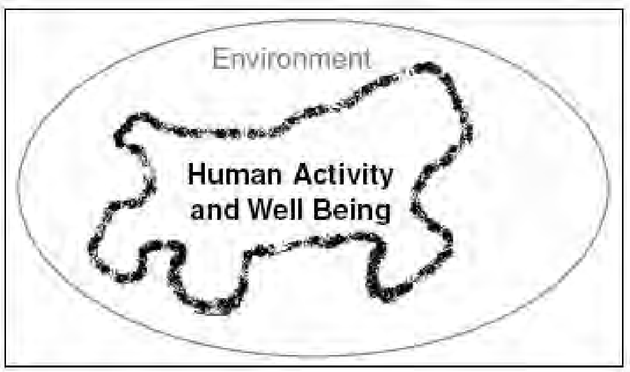
Common three-ring sector view of sustainable development

Giddings, Hopwood and O'Brien(2002) proposed nested model for economy, society and environment as follows:



Nested sustainable development–the economy dependent on society and both dependent on the environment

The boundary between the environment and human activity is itself not neat and sharp; rather it is fuzzy. There is a constant flow of materials and energy between human activities and the environment and both constantly interact with each other (Giddings, Hopwood and O'Brien,2002) shown in following Figure.



Breaking down boundaries: merging society and economy and opening up to the environment

Many Questions?

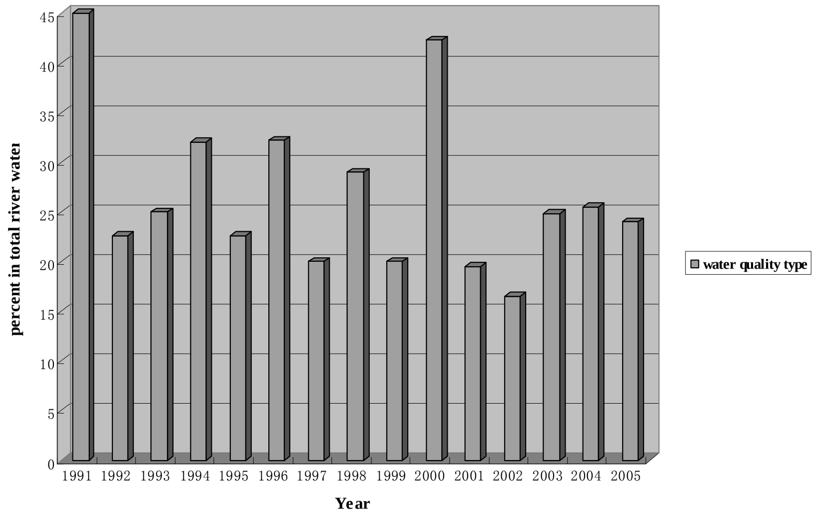
- What model of economy development can ensure human high well being and friendly environment?
- How do society development become healthy and sustainable?
- How does human dealt with the relationship among environment, economy and society to ensure human' sustainable development?

Environmental Problems in China

- Surface water environment
- Atmosphere environment
- China inshore sea water environment
- Solid waste

Surface water were seriously polluted by human activity

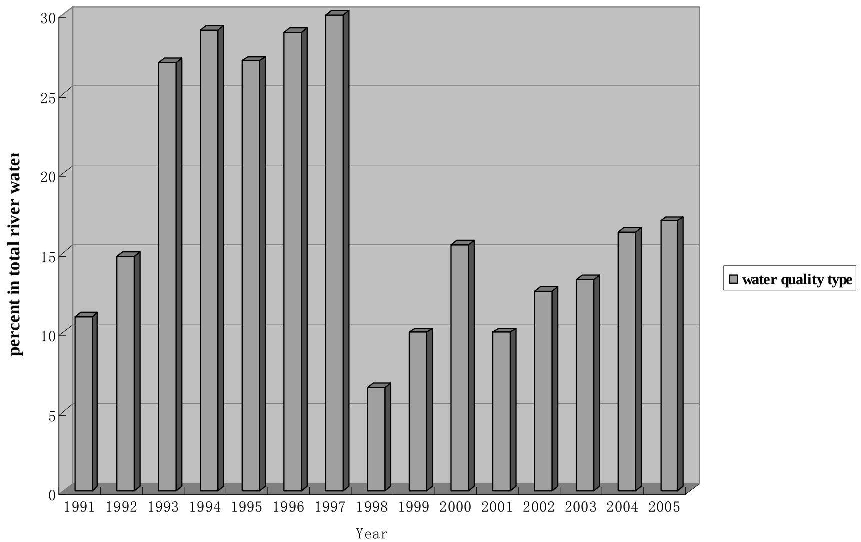
Excellent water quality type of China river water



For total trend, good water quality decrease, but in recent years good water quality increase due to water resource management by centre government

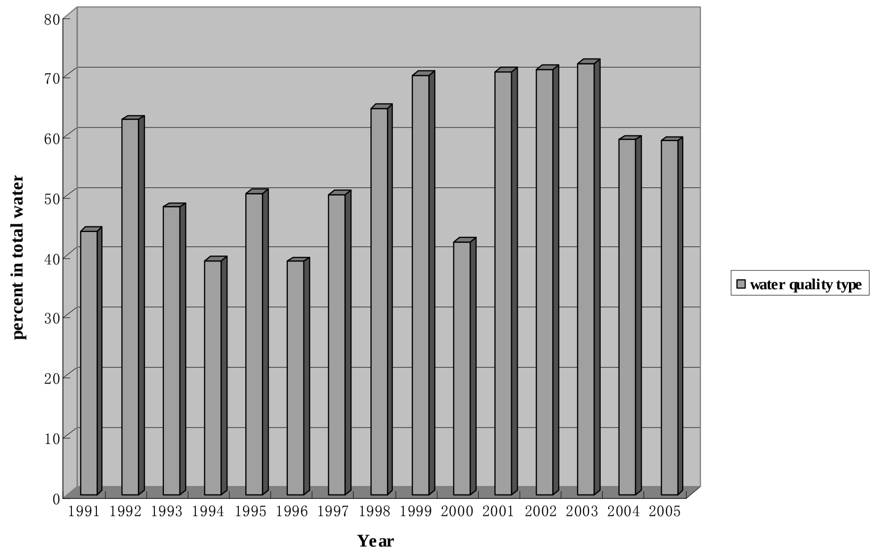
of China

Good water quality type of China river water

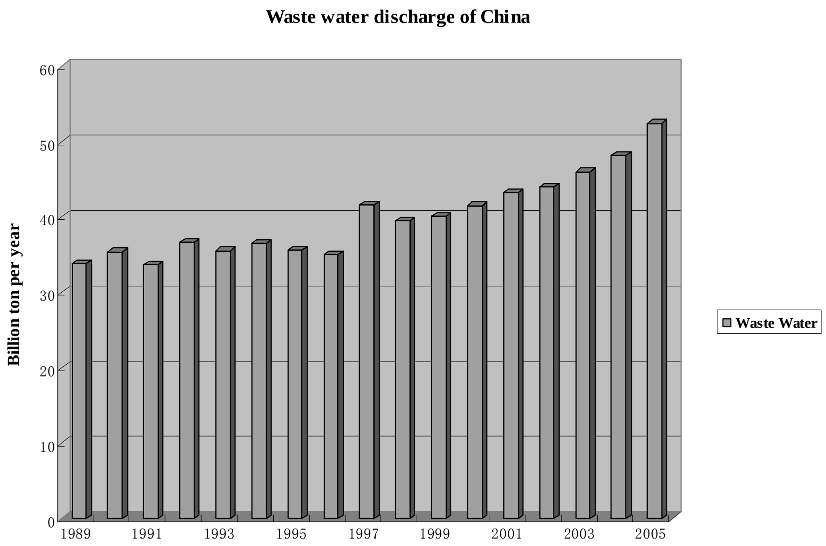


For total trend, bad water quality increase, but in recent years bad water quality decrease due to water resource management by centre government of China

Very low water quality type of China river water



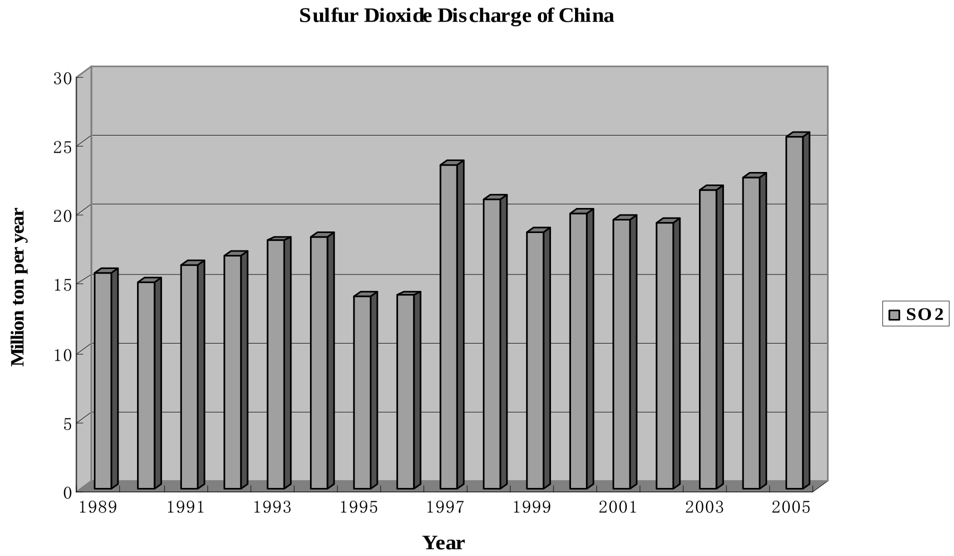
Waste water discharge increases yearly from 1989 to 2005



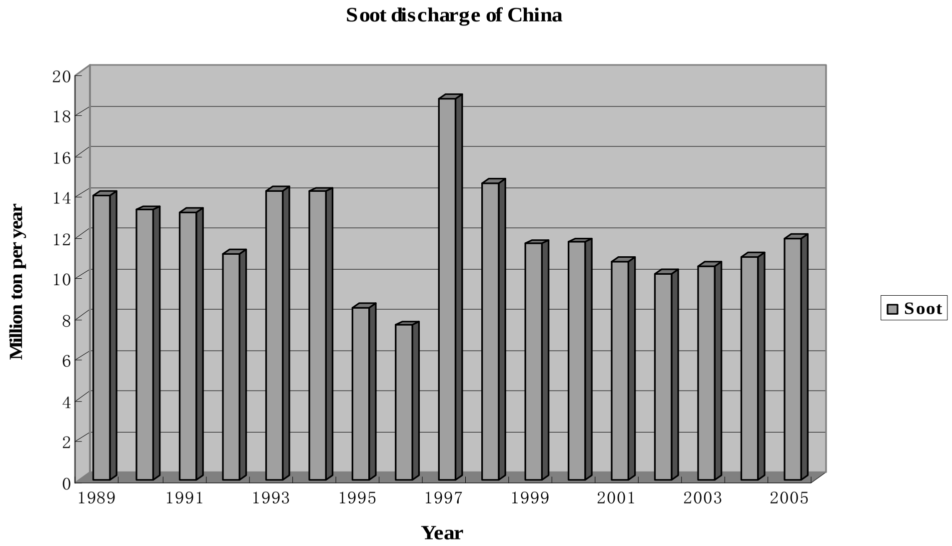
Atmosphere environment

- Air quality degrades from 1989 to 2000. But in recent years air quality of China is straightening up.
- Sulfur dioxide discharge of China is increased.

Industry activity increases sulfur dioxide discharge of China

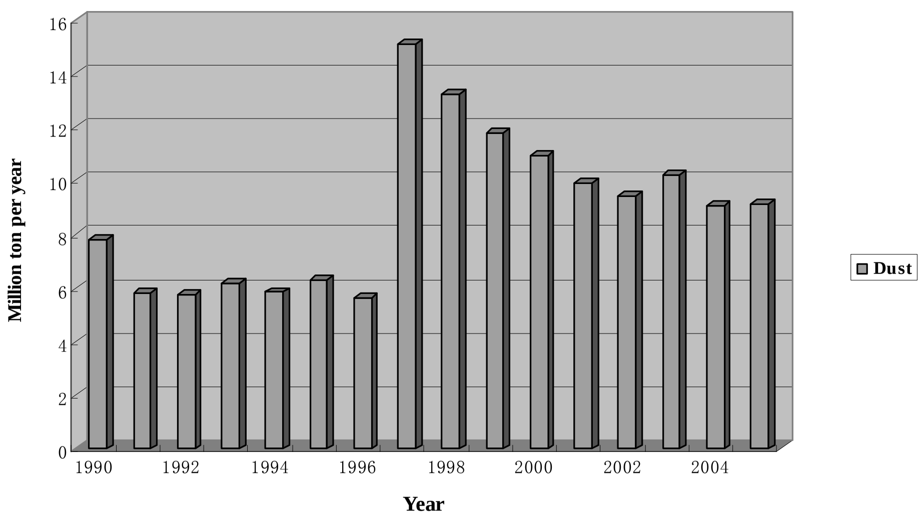


Soot discharge reached highest value. Since 1997, Soot discharge has yearly decreased due to government management.



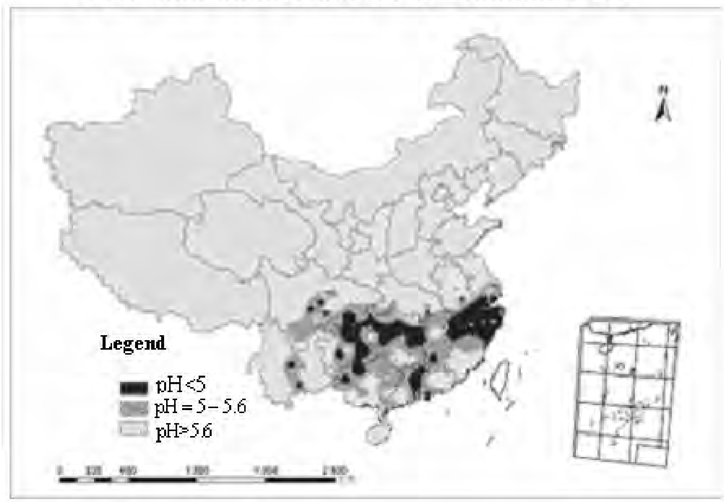
Industry dust discharge reached highest value. Since 1997, Industry dust discharge has yearly decreased due to government management.

Industry Dust Discharge of China

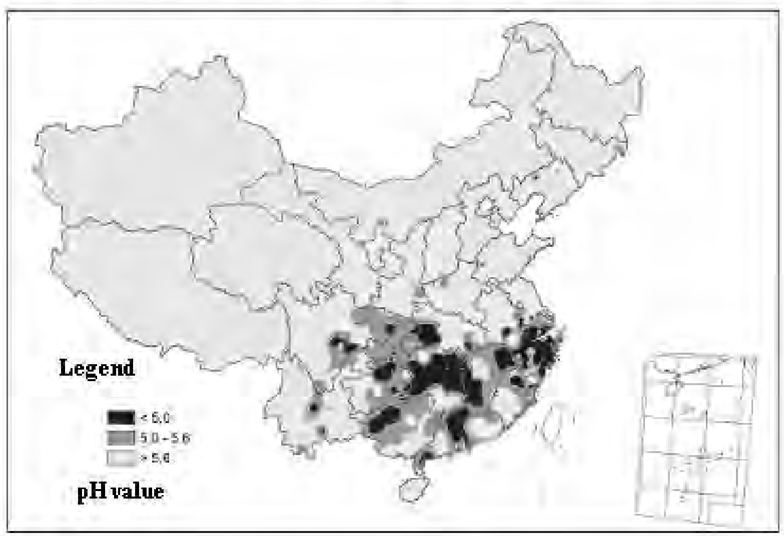


Acid rainfall of China

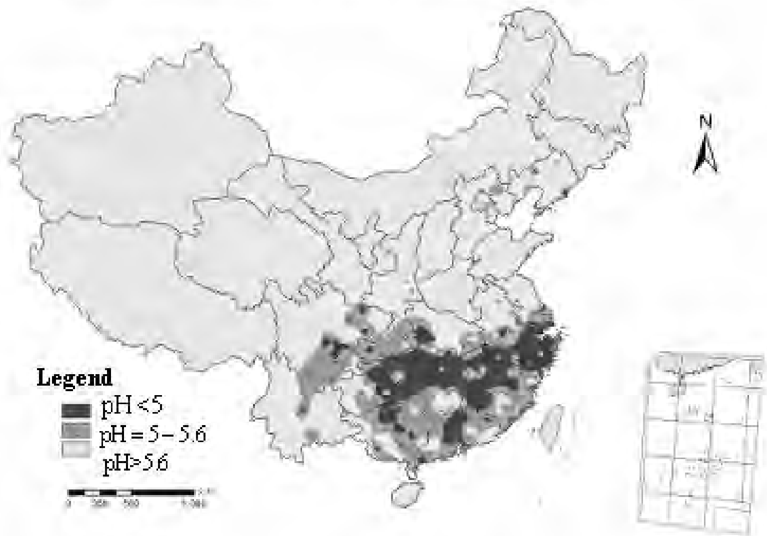
Acid rainfall distribution of China in 2002

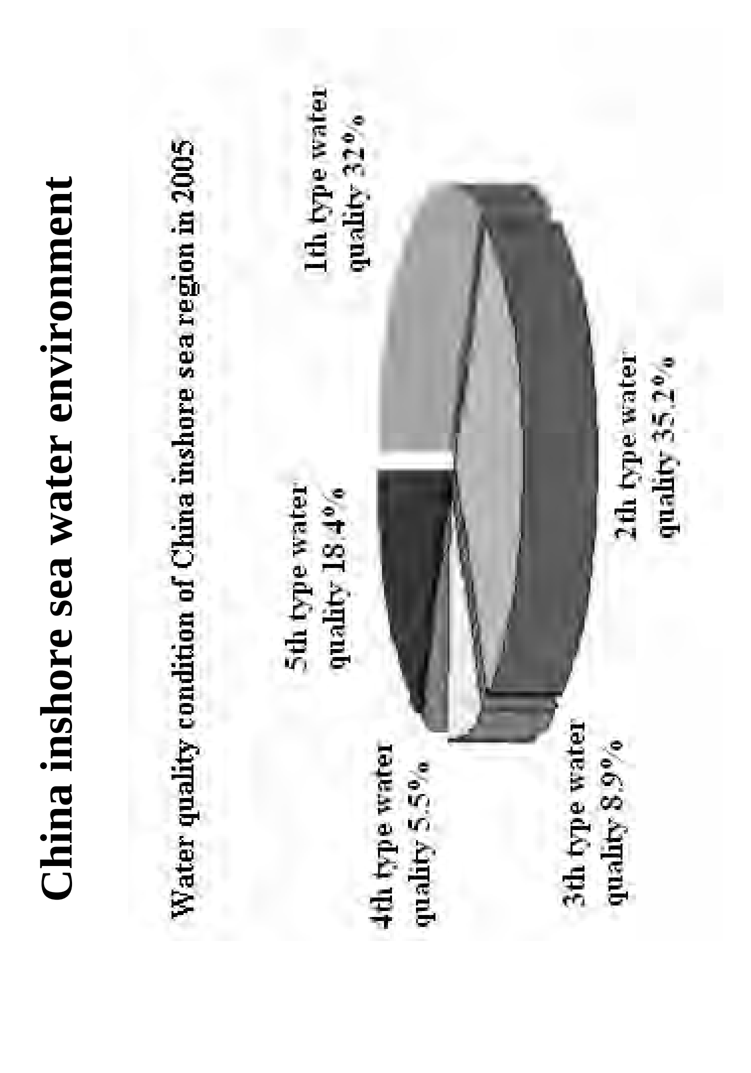


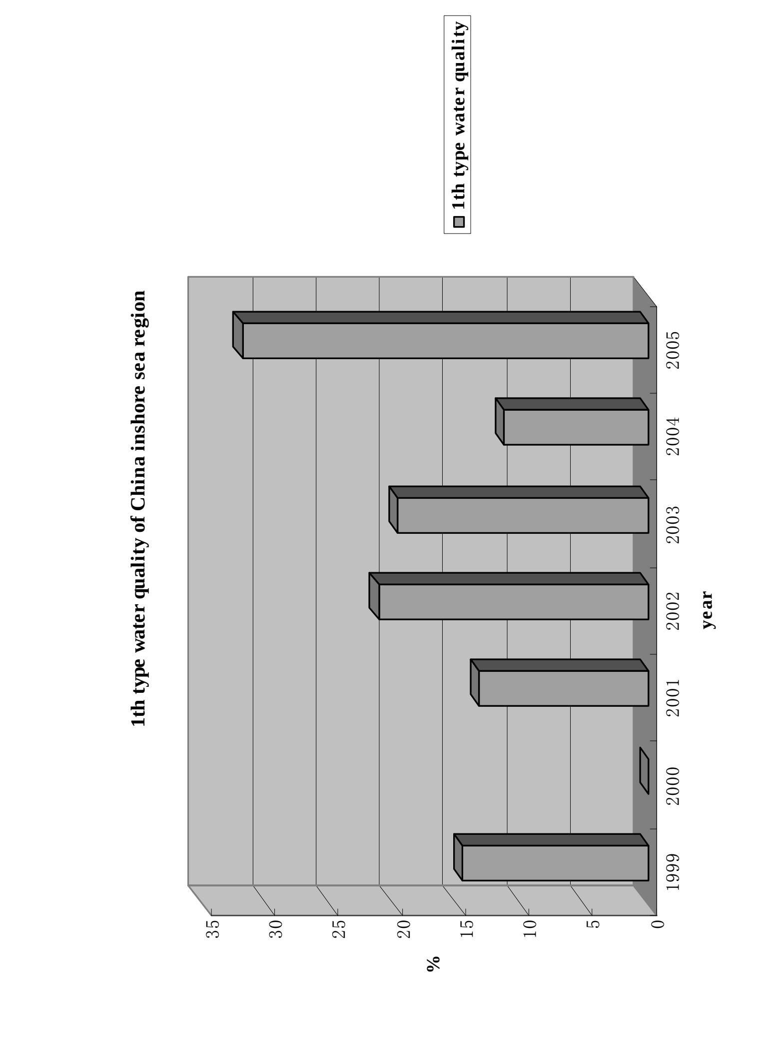
Acid rainfall distribution of China in 2003

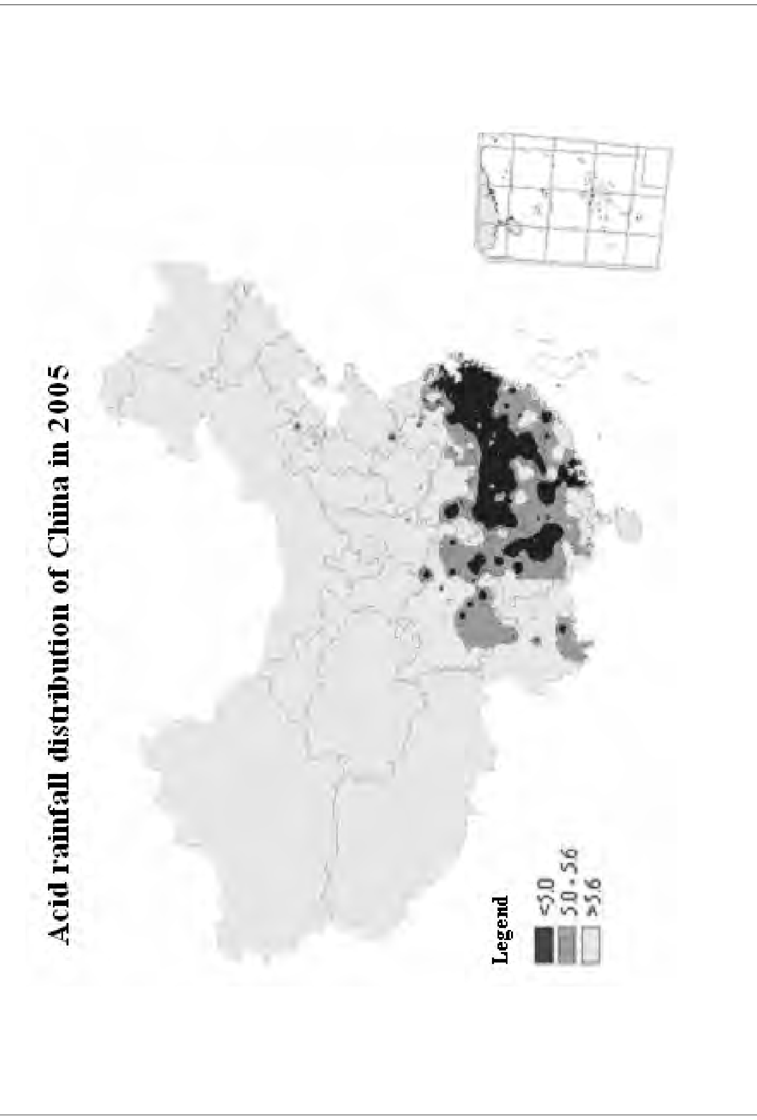


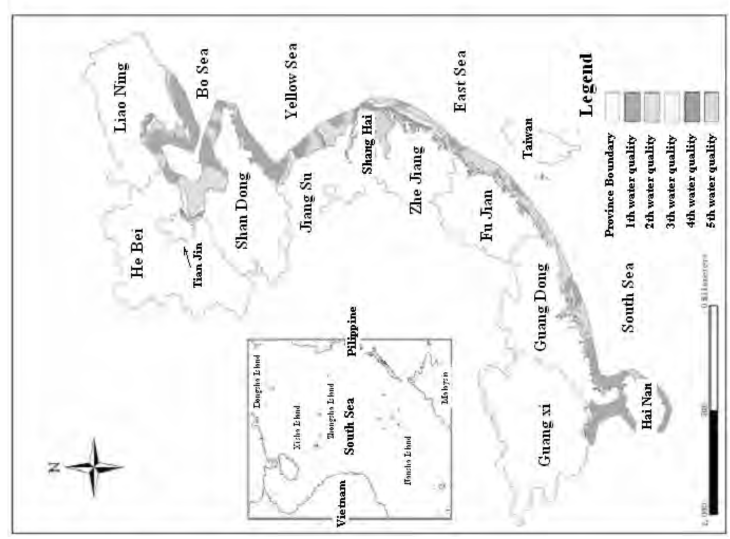
Acid raifall distribution of China in

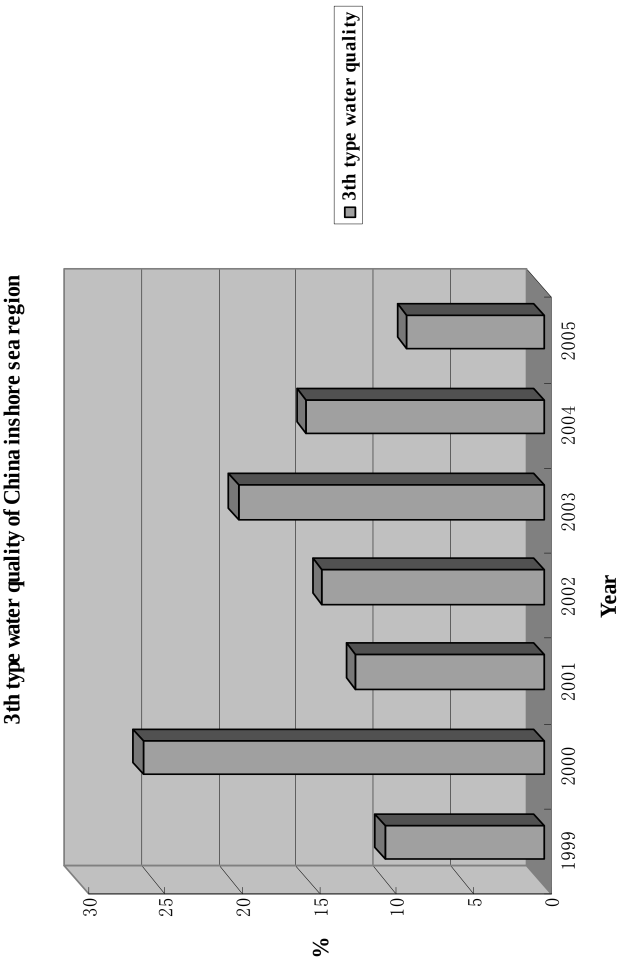


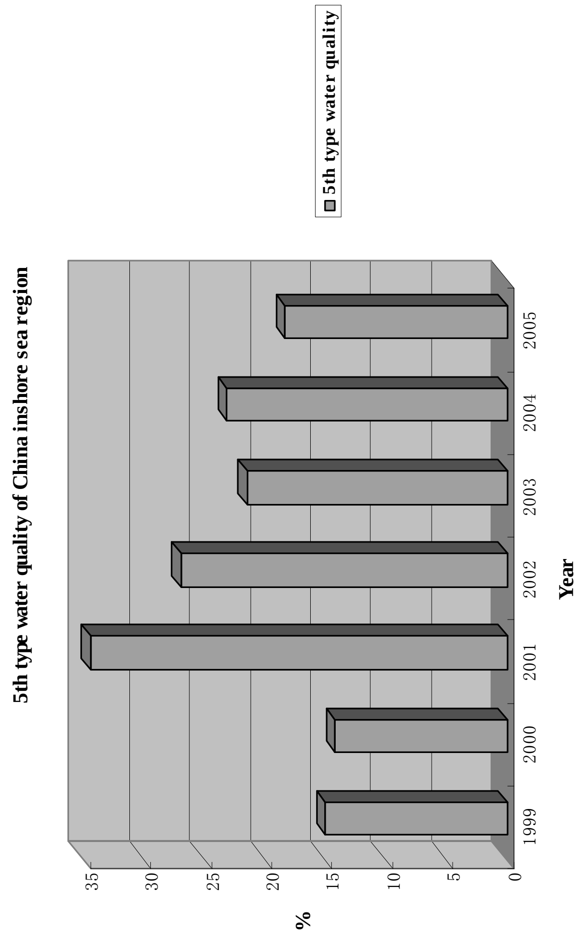

China inshore sea water environment
Water quality condition of China inshore sea region in 2005
1th type water quality 32%
2th type water quality 35.2%
3th type water quality 8.9%
4th type water quality 5.5%
5th type water quality 18.4%

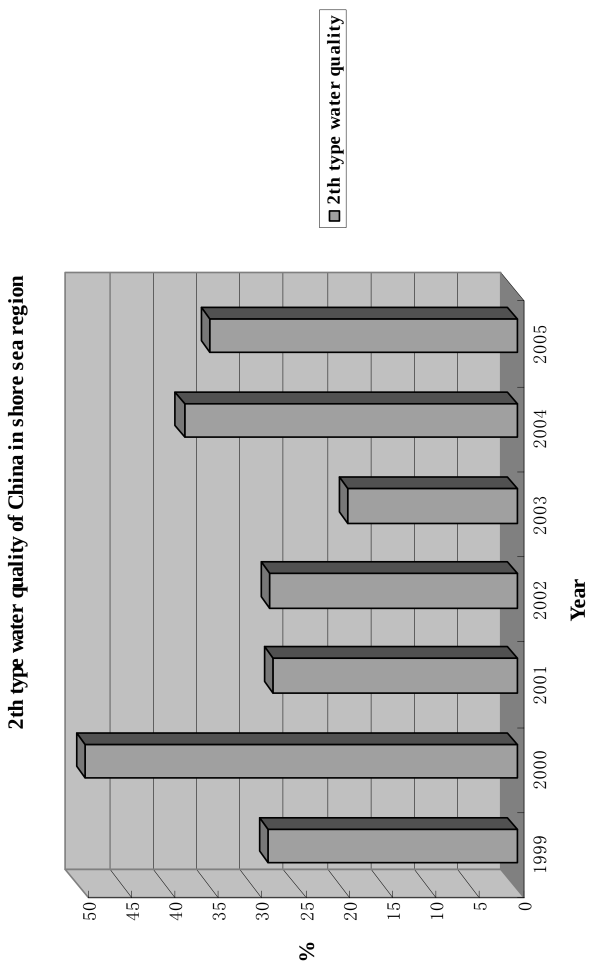

1th type water quality of China inshore sea region
%
35
30
25
20
15
10
5
0
1999
2000
2001
2002
2003
2004
2005
year
1th type water quality

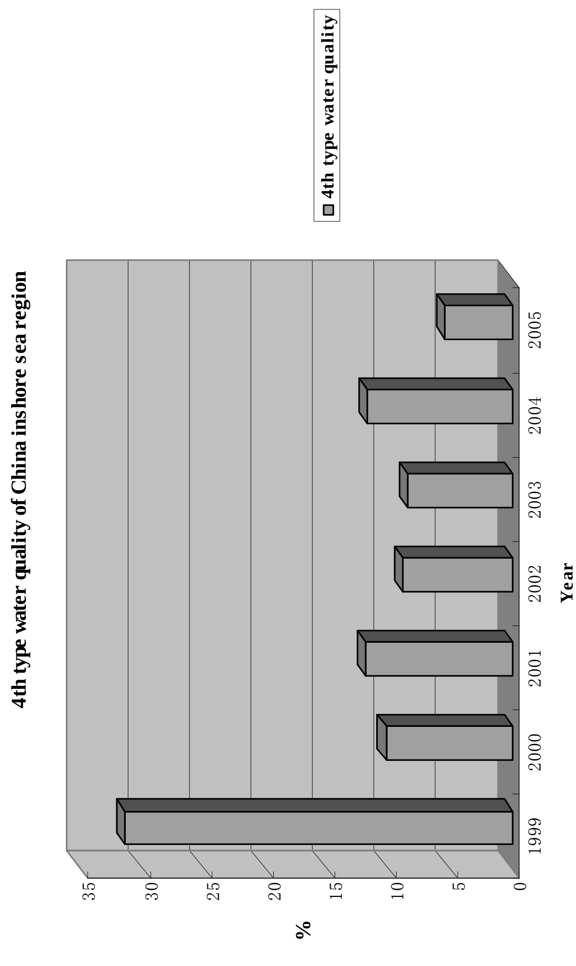

Acid rainfall distribution of China in 2005
Legend
<5.0
5.0 - 5.6
>5.6


N
Liao Ning
Bo Sea
Yellow Sea
East Sea
He Bei
Tian Jin
Shan Dong
Jiang Su
Shang Hai
Zhe Jiang
Fu Jian
Taiwan
Guang Dong
Guang xi
Hai Nan
South Sea
Vietnam
Pilippine
Legend
Province Boundary
1th water quality
2th water quality
3th water quality
4th water quality
5th water quality


3th type water quality of China inshore sea region
3th type water quality
%
Year
1999
2000
2001
2002
2003
2004
2005
0
5
10
15
20
25
30

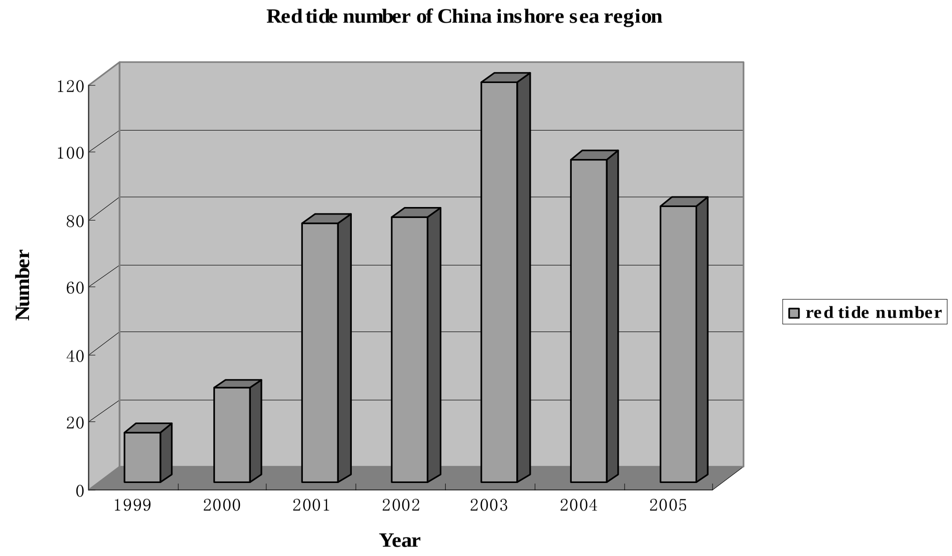

5th type water quality of China inshore sea region
5th type water quality
%
Year
1999
2000
2001
2002
2003
2004
2005
0
5
10
15
20
25
30
35

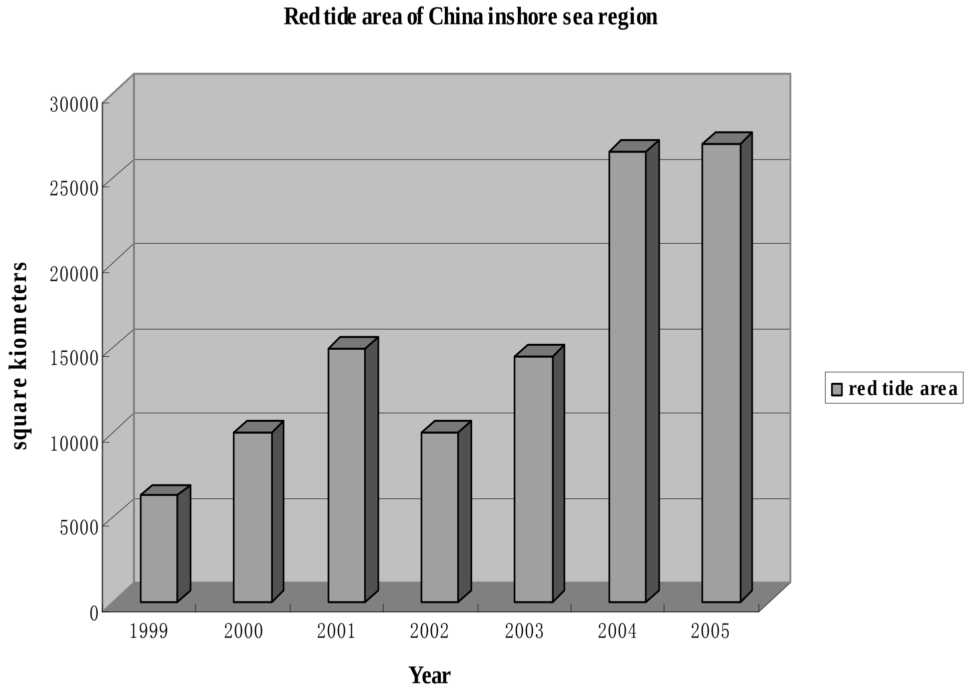

2th type water quality of China in shore sea region
2th type water quality
%
Year
1999
2000
2001
2002
2003
2004
2005
0
5
10
15
20
25
30
35
40
45
50


4th type water quality of China inshore sea region
4th type water quality
%
Year
1999
2000
2001
2002
2003
2004
2005
0
5
10
15
20
25
30
35

- China inshore sea water environment was polluted by human activity. In the recent years, sea water quality have a trend improvement due to China government Management.

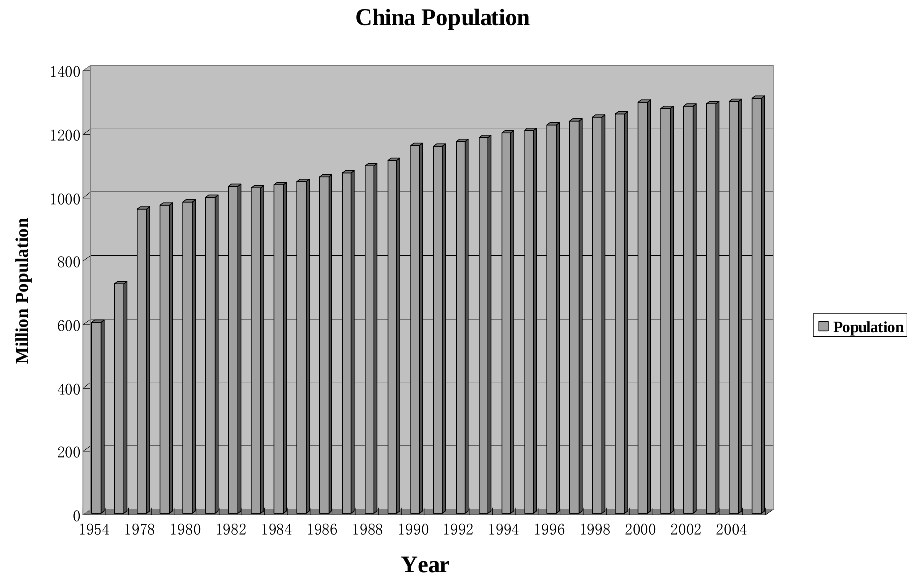
Rea tide in China inshore sea region



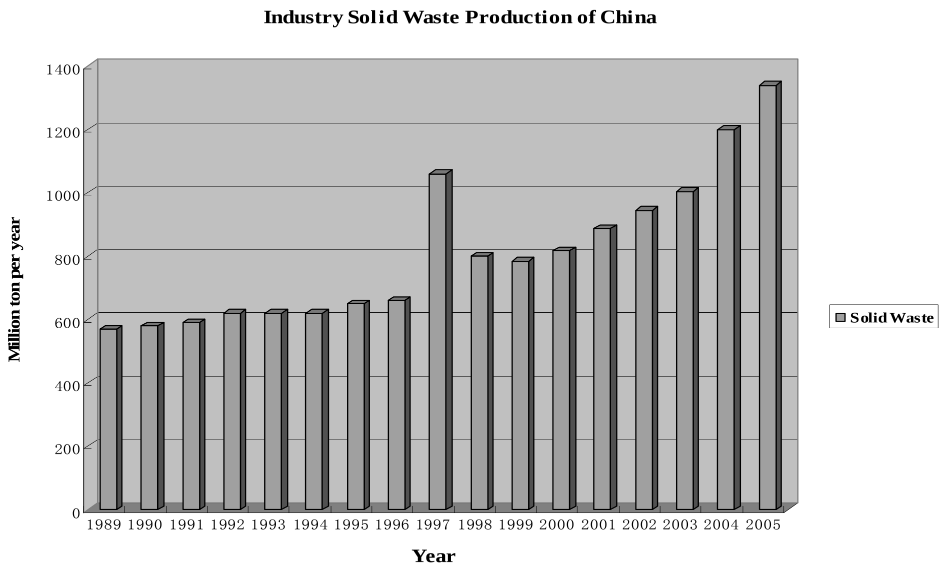


- Rea tide number decreases, but red tide area increases, especially in China east sea. We should control the discharge of waste water.

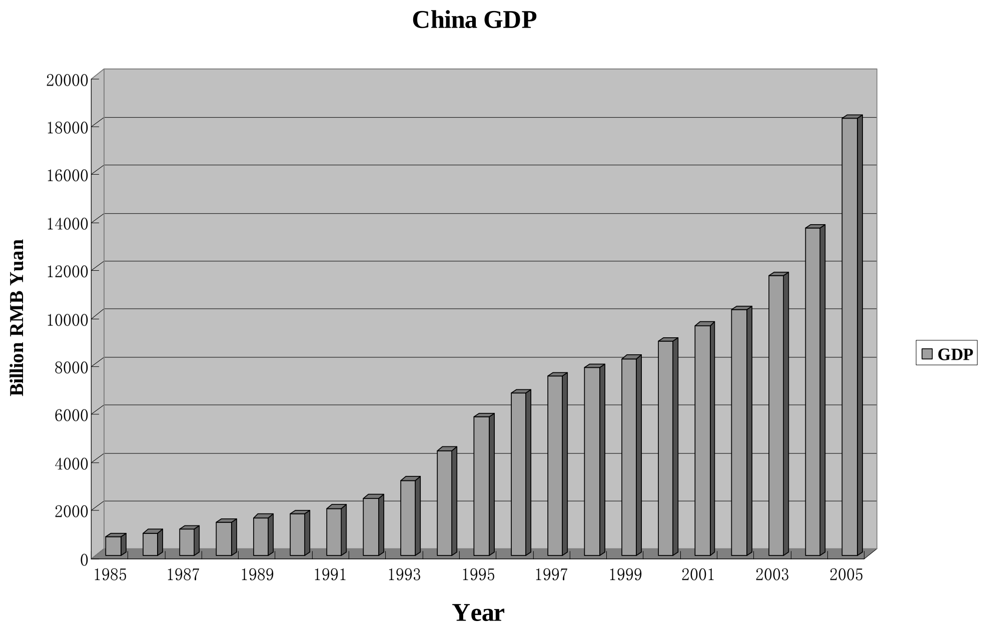
China population increases yearly.



Industry solid waste of China increases with economy development.



China GDP has rapidly increases in post 20 years.



- Consumption of Resources and energy have resulted in environmental problems due to China population and GDP increase. But in recent years China environment have a little improvement. These show that management, science and technology, modified mode of economy development is effective.

Strategies of Solving Environmental Problems

- 1) to change in living pattern and production mode, to change traditional natural opinion about human being as center of natural world, and to set up the development opinion of harmoniousness between human and nature
- (2) to construct "ecological city" and "ecological industry", to sparkplug a close-loop economic system

- (3) to environmental laws and enhance environmental management, EGDP evaluation index instead of GDP index
- (4) to enhance environmental science research and increase the investments of environmental science research and polluted environment remediation

- (5) to educate the common people to enhance civil environmental consciousness and become widely participant
- (6) to set up mechanism and forum globe environment assessment and increase international cooperation in environmental field

- 7) Set up Harmonious relationship among society, economy and environment. We should farther study theory of sustainability science

Profile

Name Yanqing Wu, Ph.D.

Affiliation Dean and Professor, School of Environmental Science and Engineering, Shanghai Jiao Tong University

Education:

1978-1982 B.S., Jilin University
1985-1988 M.S., Chang'an University
1989-1992 Ph.D., Chang'an University

Professional Career:

1982-1992 Assistant Professor of Chang'an University
1992-1995 Associated Professor and Professor of Chengdu University of Technology
1995-2004 Professor of Xi'an University of Technology
1998-2004 Professor of Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy Sciences
2004-Present Professor of Shanghai JiaoTong University

Research Fields/ Interests:

- Modeling and Remediation of Subsurface Environments
- Hydrogeology and Engineering Geology
- Numerical Modeling for Water Resources and Environment
- Eco-hydrology
- Isotopic Hydrology
- Rock Hydraulics, Rock Mechanics

Ongoing Project

- A model of coupled deformation-seepage-chemical processes in variably saturated media supported by the National Natural Science Fund of China (10572090) from Jan. 2006 to Dec. 2008, 320,000RMB
- Research on bearing capacity of water resources in the Chongming Island of Shanghai China supported by Shanghai government (05DZ12007) from Sep. 2005 to Dec. 2006, 100,000RMB
- Oceanic environmental quality assessment of Shanghai sea region supported by 908 Projects of National Ocean Bureau of China from Jan. 2006 to June. 2009, 420,000RMB
- Modeling flow and transport in tailing dam supported by Jinduicheng Molybdenum Mining Inc. from May 2005 to June 2006, 190,000RMB
- Seepage analysis of discharge tunnel supported by Jinduicheng Molybdenum Mining Inc. from Dec. 2005 to June 2006, 65,000RMB

Multiple Approaches to Asian Sustainability

Kazuyoshi Okazawa,
Project Professor, Integrated Research System for Sustainability Science,
The University of Tokyo

Abstract

It is crucial to achieve sustainability in Asian region where 60% of world population lives and consecutive industrialization and rapid economic growth are expected to continue. Several approaches to address sustainability have been proposed and implemented, Japan actually has made various efforts to realize sustainable society, trying to change our society to recycling-based society, anti-global warming society, or sustainable cities. Recycling-based society is to focus on sustainable use of natural resources and anti-global warming society is to focus on sustainable energy use, whereas sustainable cities are to harmonize urban development and environment including sustainable energy use in cities. The concept of closed loop economy is to support and encourage sustainable society through rationalized use of energy and natural resources by introducing such an idea as economic activities should be done within closed circular systems.

The closed loop economy may be considered in various levels, including regional, national, and community levels. Under the flagship research project of IR3S on "closed-loop economy", the University of Tokyo is looking for a closed material and energy circulating system of biomass in an area covering a large city and neighboring villages. This is to realize sustainable agriculture in suburban areas of a large city, conservation of natural environment in the area, and renewable energy supply to a city, which can be applied to other countries in the Asian monsoon region where rice cropping agriculture is essential and large cities are mixing with farmlands. The large City and neighboring villages is considered a unit of loop economy in this case, in which food is supplied from villages to city and organic waste from the area is collected to recover energy from biomass for supplying bio fuel and other energy sources in the city.

3Rs (Reduce, Reuse and Recycle) is an effective tool to realize closed loop economy, particularly from the political point of view. As Asian countries are developing their economies in flying geese pattern, it is useful to apply technologies and production systems of preceding countries to following countries. However, the facts that social and economic situation, industrial and consumption structure, and appropriate technology are different among countries should be taken into consideration.

To achieve complex closed-loop economy requires comprehensive approaches including technological innovation, legal system (laws and regulations) and economic incentives to encourage 3R activities, and changing lifestyle through school and social education. It is also effective to set primary targets to tackle with specific technological issues. They may include: design of products to minimize energy and natural resources, easy recyclable products, and products containing no hazardous substances; development of long-life materials and products; expansion of recycling; etc.

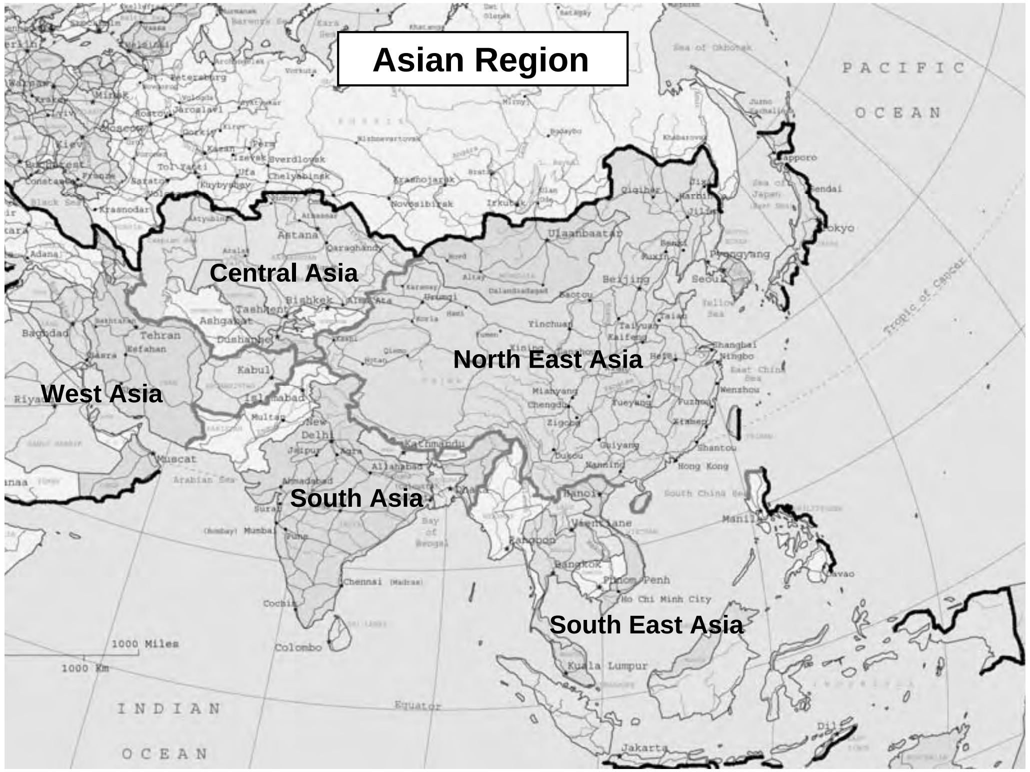
Multiple Approaches to Asian Sustainability

Kazuyoshi Okazawa

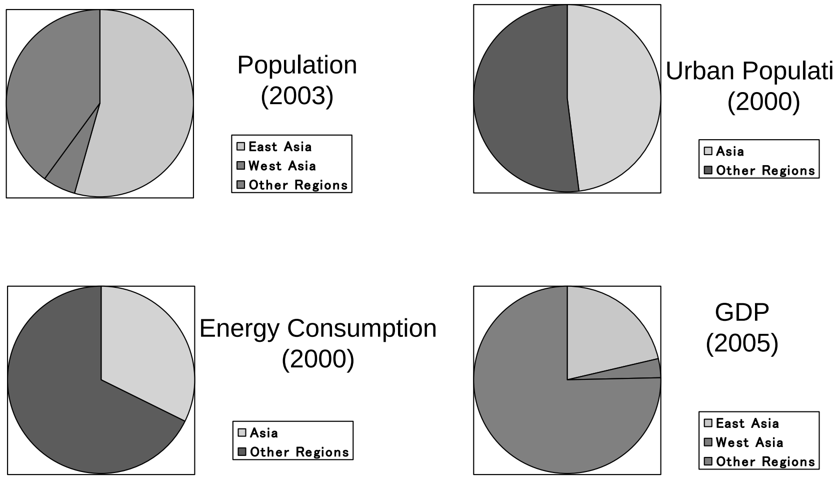
The University of Tokyo
Integrated Research System on Sustainability Science

Multiple Approaches to Asian Sustainability

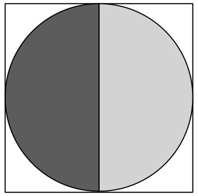
1. **Asia among the World**
2. **Approaches to Sustainable Society**
3. **3R Approaches**
4. **Community Level to Regional Level**
5. **Towards Asian Sustainability**

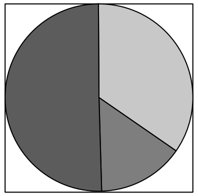


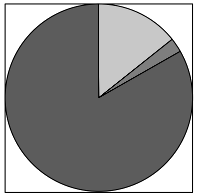
Asia among the World (1)

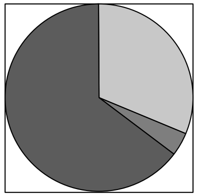


Asia among the World (2)

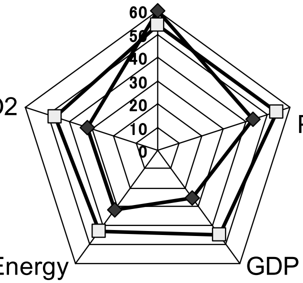








Changing Asia



Asia in 2030	
Population:	54%
Urban Population	54%
GDP:	45%
Energy Consumption	43%
CO2 Emission	46%

Estimated by EC, UNDP

Asia is going to expand its economy equivalent to the population scale

Situation of Resources and Waste

- Asia has no abundant natural resources and some rapidly industrializing countries are facing shortage of natural resources for expanding industrial production
- Asia is going to discard a large amount of end-of-life products in near future due to economic growth
- Some Asian countries are suffering from illegal import of several types of waste for resource recovery purpose, which poses a threat on human health and the environment
- Most of Asian countries are urged environmentally sound disposal of municipal waste including household waste, hospital waste and e-waste

Sustainable Society

1) Poverty Eradication
2) Sustainable Consumption and Production
3) Protection of Natural Resources
4) Protection of the Environment
5) Economic and Social Development
6) Protection & Promotion of Human Health

Closed Loop Economy
For Sound Material Cycle

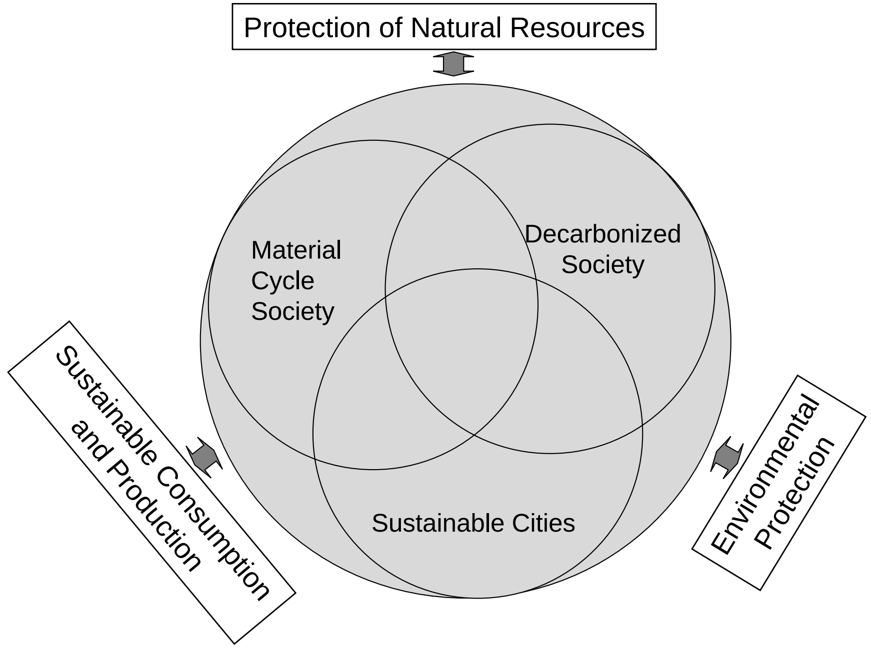
Approaches to Sustainable Society

- <u>Sustainable Cities</u>
  to improve public health and a better quality of life, by limiting waste, preventing pollution, maximizing conservation and promoting resource efficiency, based on sound local economy

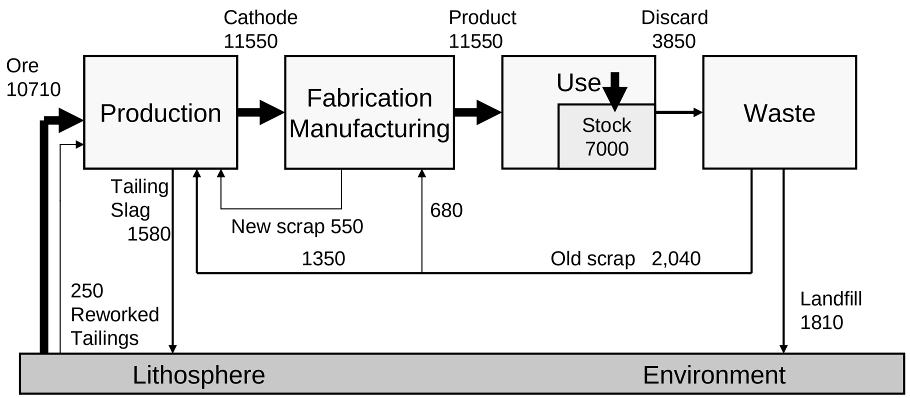
- <u>Material Cycle Society</u> (or Recycling Based Society)
  to suppress consumption of natural resources and to reduce environmental impacts through ensuring reduction of waste generation, recycling of resources, and appropriate waste disposal (Basic Law for Establishing Material Cycle Society)

- <u>Decarbonized Society</u>（Anti-Global Warming Society）
  to be free from induced phenomena of global warming through reducing greenhouse gas emissions and introducing adaptation measures

Relationship of 3 Approaches

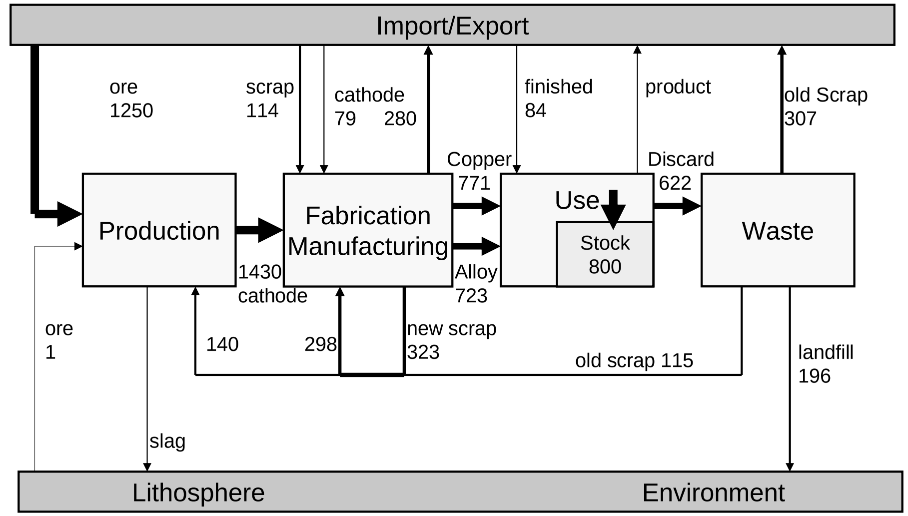


World Copper Cycle (1994)



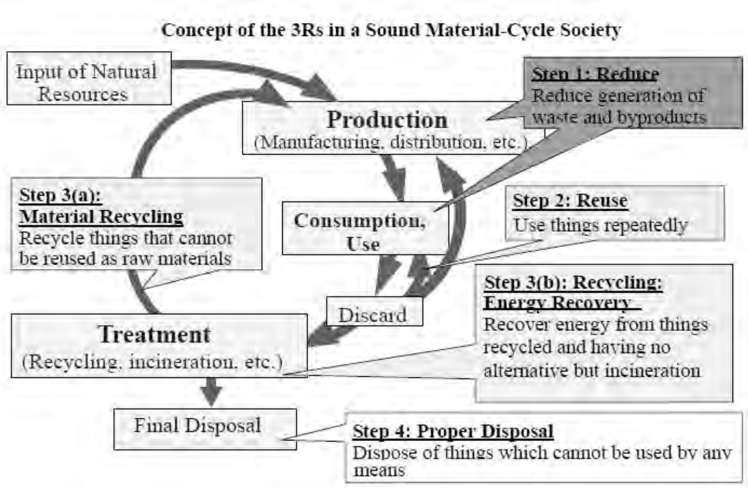
Thomas Graedel (Yale)

Copper Cycle in Japan (2003)



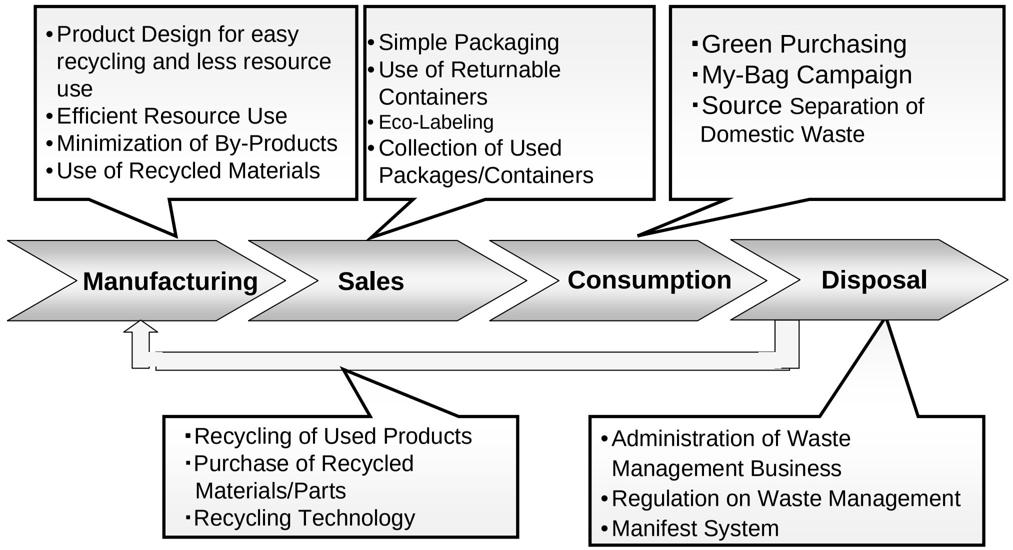
Based on data by Japan Copper Alloy Association

3Rs for Sustainable Material Cycle



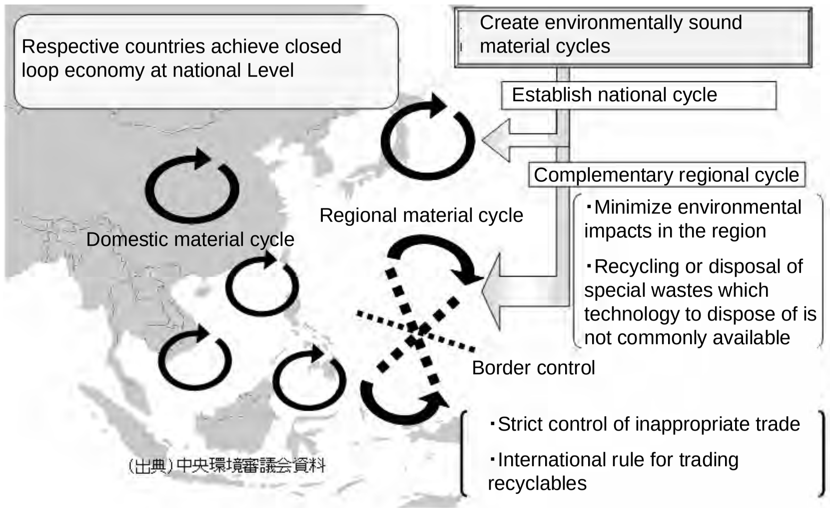
Ministry of the Environment

National Policies for 3Rs

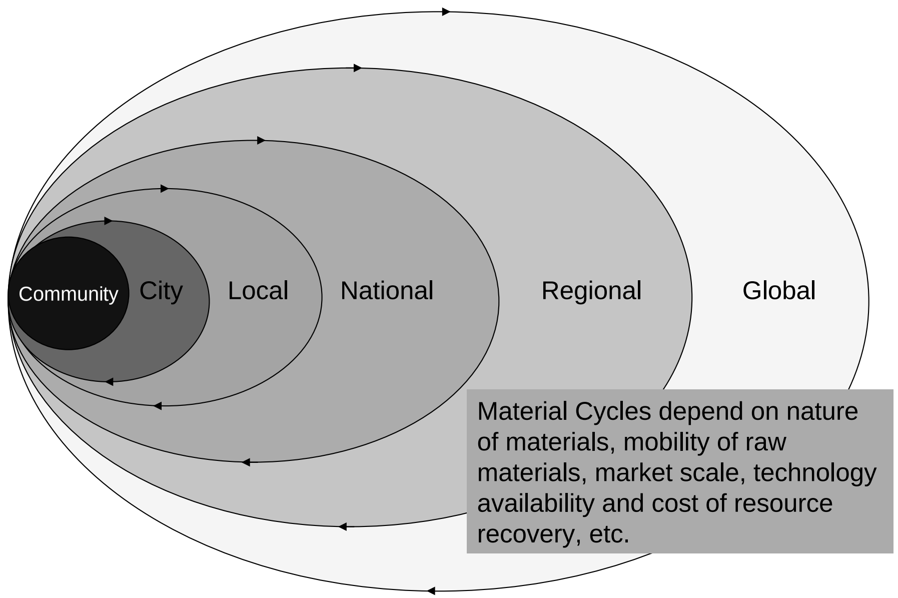


Ministry of the Environment

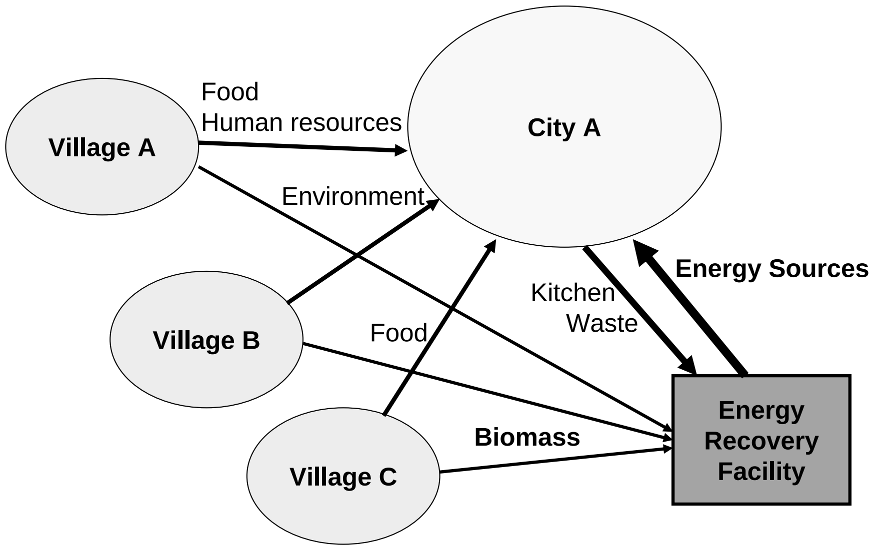
3Rs at National & Regional Levels



Scale of Material Cycles

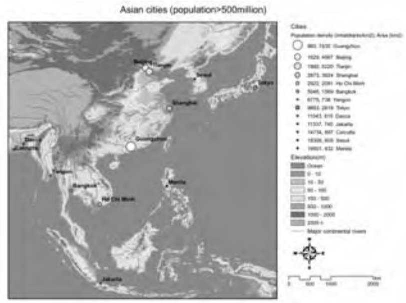


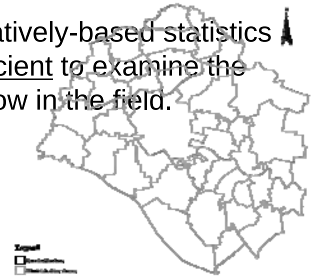
Urban-Rural Combined Model



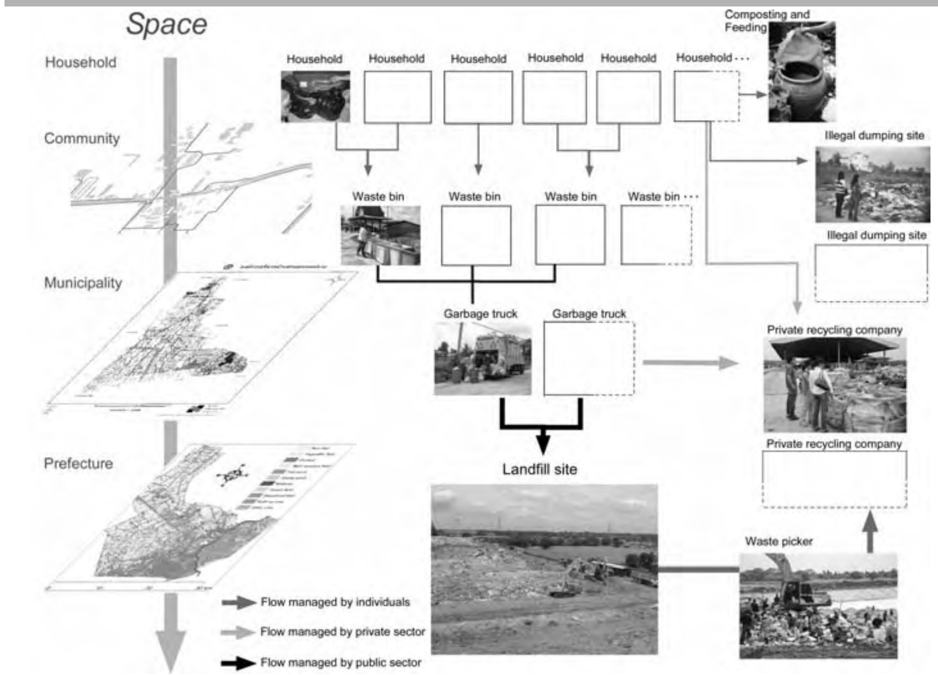
Ongoing Research by U-Tokyo

- Urban-rural land-use mixture is a common phenomenon in a low-lying Asian city.
- It has high potentiality for bioresource utilization and recycling especially.
- However, actual situation of the waste flow is not fully understood.
- Administratively-based statistics are <u>insufficient</u> to examine the detailed flow in the field.





Research Design -from the source to the end-



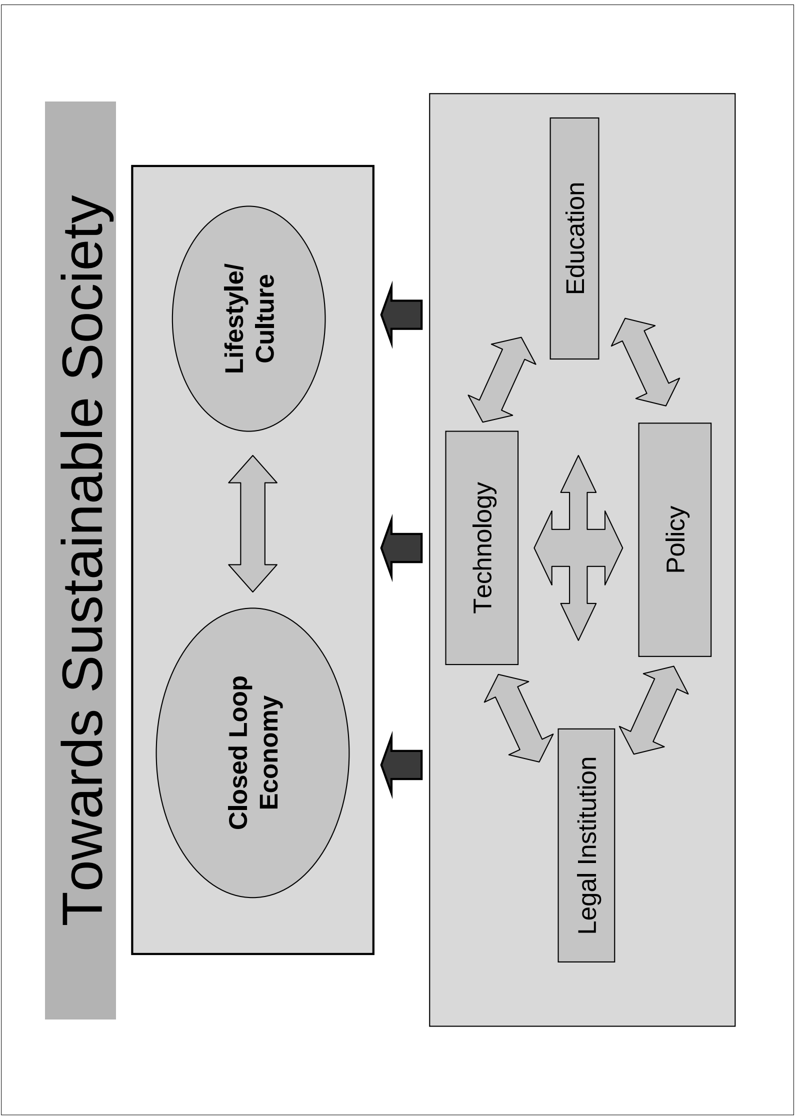
Bangkok & Tianjin Field Works

Questionnaire survey at sources (households)
-Amount of kitchen garbage etc.

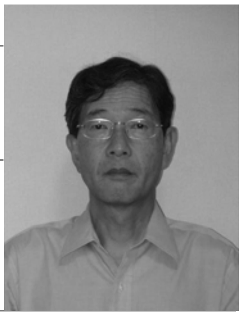
Questionnaire survey at nodes

GPS tracking for network
-Municipal garbage trucks
-Informal tricycles

Scaling-up using GIS


Towards Sustainable Society
Closed Loop Economy
Lifestyle/ Culture
Legal Institution
Technology
Policy
Education

Profile



Name	Kazuyoshi Okazawa
Affiliation	Project Professor, Integrated Research System for Sustainability Science, The University of Tokyo

Education:

1969	B.S., Department of Urban Engineering, Faculty of Engineering, the University of Tokyo
1971	M.A, Graduate School of Engineering, the University of Tokyo

Professional Career:

1999-2000	Director-General, Water Supply and Waste Management Department, Ministry of Health and Welfare
1999-2002	Director-General, Waste Management and Recycling Department, Ministry of the Environment
2002-2003	Director-General of Global Environment Bureau, MOE
2003-2005	Guest Researcher, School of Forestry & Environmental Studies, Yale University
2005-Present	Senior Advisor, Institute of Advanced Studies, U.N. University
2005-Present	Special Advisor, Japan Industrial Waste Management Promotion Center
2006-Present	Project Professor, Integrated Research System for Sustainability Science, the University of Tokyo

Research Fields/ Interests:

Policy for Sustainable Production and Consumption

On the Circular Economy Legislation of Shanghai City Guided by the Ideal of Circular Economy Society

Xi Wang, Ph.D.
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Abstract

This paper includes two parts. In the first part, the author describes the necessity, the general strategy and the main tasks of developing a circular economy in Shanghai City.

The author describes the society of circular economy as a society based upon circular economy system. In a circular society, the operation of economic system is guided by the principles of circular economy. In addition to the basic principles of market, the production, distribution, utilization and proposal of commodities in a circular economy follow the laws of ecology. Building up a circular economy is an ideal that many countries of the world work for. So, does China. The current Chinese government proposes and works hard to change the operation of Chinese economic system into a system that meets the requirements of a circular economy.

As the largest industrial and commercial city and the engine of Chinese economy, Shanghai City is taking a lead in the development of circular economy. The Municipal Government of Shanghai has proposed a strategy for developing circular economy.

In the second part of paper, the author elaborates the general strategy for the municipal legislative work of the city. The author beliefs that law play a critical role in the development of a circular economy. Historically, Shanghai has adopted many local laws and regulations related to wastes control and reuse. They constitute a good basis for the development of a legal system that meet the requirements of circular economy.

The author suggests a legislation system of circular economy for Shanghai and elaborates the major tasks of municipal legislation for promoting circular economy in the city.

The author suggests that Shanghai should absorb the experience of other cities and other countries on developing circular economy and design a local legal system that meets the principles of ecological economics. The legal system should target industries, residents and local governments and focus on energy saving energy, water, land, row materials and reuse wastes.

The author suggests that the Municipal People's Congress should to sort, draft and amend local laws to ensure the energy saving energy, water, land, row materials and reuse wastes in the city.

Legislation for Promoting Circular Economy in Shanghai

Professor Wang Xi
Environmental and Resources Law Institute (ERLI)
Shanghai Jiao Tong University

www.chinaerli.org

What is a Society of Circular Economic ?

A circular economy society is a society whoes operation is guided by the principles of circular economy.

It is a society with maximum recycling and reusing natural resources and minimum wastes, as well as disposing wastes in a way of environmentally sound.

It is a society in which human being and nature co-exist harmoniously.

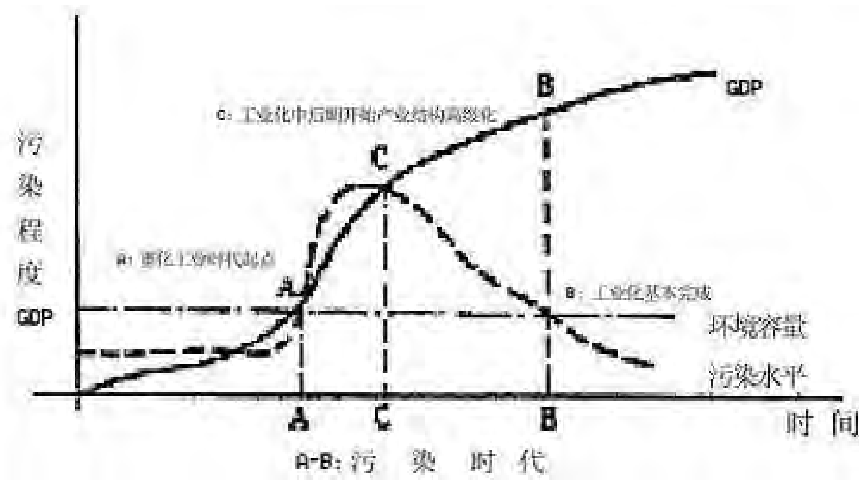
The Necessity of Building up a Circular Economy in China

- **Restrains of natural resources**
- **Costs of pollution**
- **Need of changing growth mode**
- **Need of enhancing competition ability in international trade**

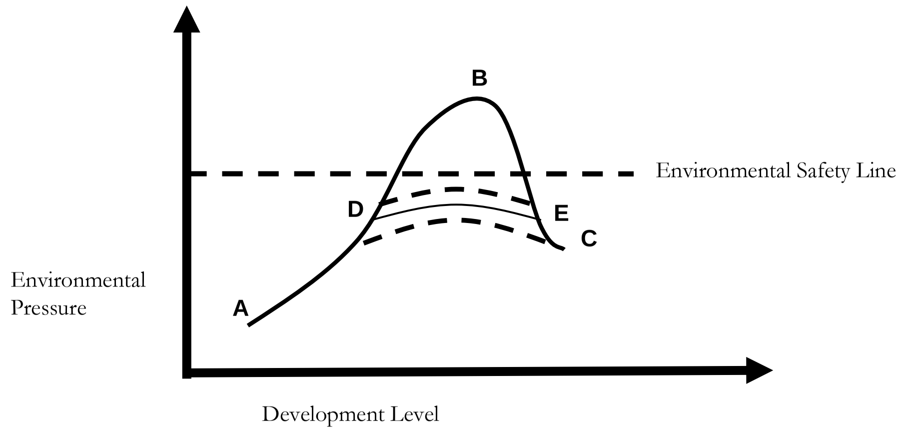
GDP Generated by Per Unit of Energy
（international dollar/kilogram stand oil）
The World Bank （2003）

	1990	1997	1998	1999	2000
Average of the world	3.5	4.0	4.1	4.2	4.5
Italy	6.6	7.8	7.6	7.8	8.2
Spain	5.6	6.2	6.2	6.3	6.4
Japan	5.3	5.8	5.7	5.9	6.1
Germany	4.0	5.3	5.4	5.7	6.1
U.K.	4.4	5.4	5.4	5.6	6.0
Holland	4.1	4.9	5.2	5.4	5.7
France	4.3	4.9	4.8	5.0	5.4
Argentina	5.3	7.2	7.3	6.9	7.2
Brazil	5.9	6.5	6.2	6.4	6.7
Mexico	4.0	4.9	4.9	5.1	5.5
India	3.8	4.9	5.0	5.3	5.5
U.S.A.	3.0	3.8	3.9	4.0	4.2
China	1.7	3.2	3.5	3.8	4.1

Environmental Kuznets Curve



The Channel of Sustainable Development



The Relationship between Circular Economy and Law

- Circular economy depends on law.
- Law provides basic rules of conducts and social order for the development and operation of circular economy.

The Necessity of the Legislation for Promoting Circular Economy in Shanghai

- Large scale of economy
- Huge sized population
- Lack of natural resources
- Large scale of natural resources consumption
- Limited supporting capability of environment
- Competition ability in trade

- How the law accepts the concepts of circular economy and circular economy society?
- How the law promotes the development of a circular economy in Shanghai?

The Strategy and Main Tasks of Developing Circular Economy in Shanghai

Strategy

- Reduce energy consumption through structure modification, technology upgrading and system reform.
- Recycling resources of small scale (factory), middle scale (industrial zone) and large scale (whole city).
- Reduction, reuse and recycling at all stages (Input, Process and Output) of production.
- Joint promotion by market, society and government.
- Regional cooperation (Shanghai, Jiangsu and Zhejiang)

Main Tasks

- Readjustment of the industrial structure and the development of a environmental friendly industry
- Energy conservation
- Improving land use efficiency
- Water saving
- Cleaner production
- Ecological agriculture
- Recovery and reuse of renewable resources
- Reducing package material consumption

Strategy of Developing a Legal System on Circular Economy in Shanghai

- Learning the beneficial experience of legislation on circular economy from all over the world.
- Targeting industrial sectors, citizens and governments.
- Priorities: Saving energy, water, soil, material and reusing wastes.
- Coordinate and modify relevant existing laws, regulations, rules and standards.

Eight Keys

- Learning
- Legitimate
- Scientific basis
- Based upon the strategy for developing circular economy in Shanghai
- Clearly targeted actors
- Priorities
- Clear tasks
- Clear goals and objectives.

Framework of the Legislation on Circular Economy of Shanghai

- **Level one:** A Decision of the Standing Committee of the Shanghai People's Congress on Promoting Circular Economy in Shanghai
- **Level two**: Specialized Regulations promulgated by the Standing Committee of the Shanghai People's Congress
- **Level three:** Specialized provisions and rules made by the various departments of the City Government of Shanghai.
- **Level four:** Standards related to circular economy.

The End. Thank you!

Profile

Name	Xi Wang, Ph.D.
Affiliation	Associate Dean and Professor, School of Law, Shanghai JiaoTong University

Education:

1981	B.A., Department of Chinese Literature and Language, Wuhan Normal College, P.R.C.
1984	M.L., Department of Law, Wuhan University, P.R.C.

Education:

1981	B.A., Department of Chinese Literature and Language, Wuhan Normal College, P.R.C.
1984	M.L., Department of Law, Wuhan University, P.R.C.
1987	M.J.S., School of Law, Washington University, U.S.A.
2000	Ph.D. (Law), School of Law, Wuhan University, P.R.C.

Professional Career:

1984-2002	Assistant Lecturer (1984-1987), Lecturer (1988-1992), Associate Professor (1993 -1995), Professor (1995), School of Law, Wuhan University, China
2000-2002	Deputy Procuratorate General and Public Prosecutor, The People's Procuratorate of Hubei Province, China
2002-Present	Associate Dean of the School of Law (for research and international cooperation) Professor, Director of Environmental and Resources Law Institute (ERLI), Shanghai JiaoTong University, China

Committee/ Boards:

- Vice Chairman, Chinese Society of Environment and Resources Law
- Member, Academic Committee of Environmental Law, The Key Research Institute of Humane and Social Science, Ministry of Education of PRC
- Board Member, Chinese Association for Environmental Protection
- Board Member, Chinese Society of Sustainable Development;
- Member, Commission on Environmental Law, IUCN-The World Conservation Union;
- Member, Governing Council, IUCN Academy of Environmental Law;
- Member, Editorial Committee, Journal of Asian Pacific Environmental Law, Sydney University, Australia;
- Member, Editorial Committee, Journal of International and Comparative Environmental Law, Mcquarie University, Australia
- Reporter of China, Yearbook of International Environmental Law, Oxford University Press, UK.

Selected Publications:

- Wang Xi, International Environmental Law (in Chinese, National University Textbook), First Edition (1998), Second Edition, , Law Press China, Beijing, 2005.
- Wang Xi, Introduction to American Environmental Law (in Chinese), Wuhan University Press, 1992.
- Wang Xi, Chief Editor, International and Comparative Environmental Law (in Chinese), first and second volumes, Law Press China, Beijing, 2002, 2005.
- Wang Xi, co-edited with Adrian J. Bradwook, etc., The Law of Energy for Sustainable Future, Cambridge University Press, 2005.
- Wang Xi, co-author, Environmental Law and Enforcement in the Asia-Pacific Rim, Sweet & Maxwell-Asia, Hong Kong, 2002;
- United Nations: New Agenda and New Challenges, Shishi Publishing House, Contributed Chapter 5, 2005;
- Study on Wetland Conservation Legislation of China, Law Press China, Co-author, 2004;
- The Great Encyclopedia of China, The Great Encyclopedia Publishing House, Contributed articles on international environmental law, 2002
- The Law of Energy for Sustainable Development, Cambridge University Press, Co-Chief Editor, 2005

Environmental Management in Industrial Development: Resources Conservation and Material Recycling Strategy in Vietnam

Phung Thuy Phuong, Ph.D.
Lecturer, University of Natural Sciences, Vietnam National University-Ho Chi Minh City

Abstract

Choosing industrialisation as a key development strategy, Viet Nam is now facing with environmental challenges. Our generation has no right to get short term economic benefits, leaving long term environmental disasters to future generations. Measures to compromise economic and environmental goals should be considered. One among these measures is to organise industrial systems based on an industrial ecology approach. The main idea of Industrial Ecology is that for sustainable development, industrial systems should mimic natural ecosystems. In other words, the material cycles in industrial systems should be closed, similar to material cycles in natural ecosystems. The purpose of this paper is to analyse the advantages and constraints to apply the concept of industrial ecology, and to suggest some ideas to promote industrial ecology in Viet Nam.

ENVIRONMENTAL MANAGEMENT IN INDUSTRIAL DEVELOPMENT: RESOURCES CONSERVATION AND MATERIAL RECYCLING STRATEGY IN VIETNAM

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Paper presented at The Conference on ‘ Sustainable Society and Industrial Transformation with Zero Emission Inititatives’
Ho Chi Minh City, Vietnam November 6-7, 2006

ENVIRONMENTAL MANAGEMENT IN INDUSTRIAL DEVELOPMENT: RESOURCES CONSERVATION AND MATERIAL RECYCLING STRATEGY IN VIETNAM

- INTRODUCTION
- INDUSTRIAL ECOLOGY: POLLUTION PREVENTION APPROACH
    - Industrial Metabolism
    - Industrial Ecosystem
    - Industrial Ecology
- INDUSTRIAL ECOLOGY IN PRACTICE
    - Denmark
    - USA
    - Canada
    - The Netherlands
    - Thailand
- INDUSTRIAL TRANSFORMATION IN VIETNAM: RESOURCES CONSERVATION AND MATERIAL RECYCLING

INTRODUCTION

- Industrial development challenges: natural resource scarcity, and environmental deterioration.
- End-of-pipe technologies are in general costly and do not provide any help to solve the problem of natural resource scarcity.
- Industrial Ecology: Preventive approach, new perspective to develop industrial systems towards ecologically sound direction.

INDUSTRIAL ECOLOGY: POLLUTION PREVENTION APPROACH

Industrial Metabolism

The metabolism of industry is the whole integrated collection of physical processes that convert raw materials and energy plus labour, into finished products and waste in a (more or less) steady-state condition

Industrial activities are not separated from the metabolism of the biosphere and that it is human economic and industrial activities that causes the problem of global change through their interfere in the ecological balance and natural cycles .

INDUSTRIAL ECOLOGY: POLLUTION PREVENTION APPROACH

Industrial Ecosystem

Natural cycles (of water, carbon/oxygen, nitrogen, sulfur, etc.) are closed, whereas industrial cycles are open.

Frosch and Gallopoulos (1989) **:** industrial systems should mimic ecosystems (the concept of industrial ecosystem).

The transformation of the traditional model of industrial activity, in which individual manufacturing takes in raw materials and generates products to be sold plus waste to be disposed of, into a more integrated system, in which the consumption of energy and materials is optimized and the effluents of one process serve as raw materials for another process.

Industrial Ecosystem concept focuses on the relations between companies in a direct waste/by-product exchange.

INDUSTRIAL ECOLOGY: POLLUTION PREVENTION APPROACH

Industrial Ecology

3 key elements of the industrial ecology perspective:

- It is a systemic, comprehensive, integrated view of all the components of the industrial economy and their relations with the biosphere.
- It emphasizes the biophysical substratum of human activities, i.e. the complex patterns of material flows within and outside the industrial system, in contrast with current approaches that mostly consider the economy in terms of monetary units.
- It considers technological dynamics as a crucial (but not exclusive) element for the transition from the actual unsustainable industrial system to a viable industrial ecosystem.

At the most basic level, the Industrial Ecology perspective describes a system in which one industry's wastes (outputs) become another's raw materials (inputs). Industrial ecology offers options which are not only effective for protecting the environment, but also for optimizing the use of scarce resources

INDUSTRIAL ECOLOGY: POLLUTION PREVENTION APPROACH

Industrial Ecology acknowledges the existence of a wide range of ***industrial ecosystems*** with varying degrees and patterns of interactions with the biosphere. Each industrial ecosystem is characterized by the flows of materials and energy ***(industrial metabolism)*** similar to those going through a natural ecosystem

INDUSTRIAL ECOLOGY IN PRACTICE

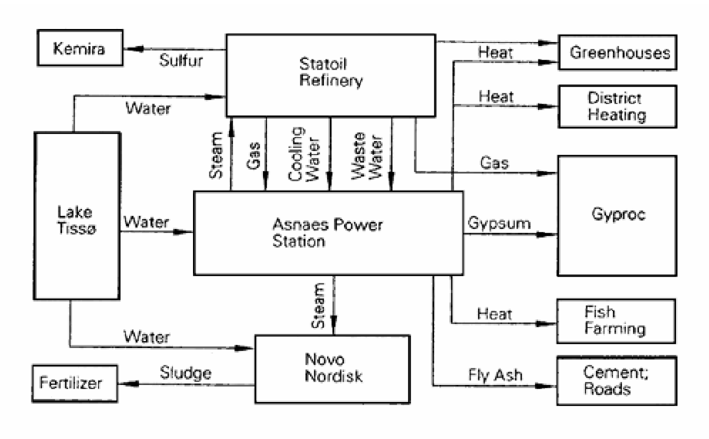
- Industrial symbiosis

  A group of industries work collaboratively through exchanges of materials, energy, water, and by-products to reduce natural resources consumption and pollution
- Industrial Ecosystem/Eco-Industrial Zone/Eco-park

  A community or network of companies and other organizations in a region or a physical zone/park who interact by exhanging and making use of by-products and/or energy in a way that provides one or more benefits over the traditional, non-linked operations. Those benefits include: reduction in natural resources use for input; reduction in pollution; reduction in energy use; reduction in disposal of wastes; increase in value of non-product outputs.

INDUSTRIAL ECOLOGY IN PRACTICE

Denmark: Kalundborg



INDUSTRIAL ECOLOGY IN PRACTICE

Denmark: Kalundborg

Investment 60 Million USD

Revenues of Participating companies 129 Million USD

Reduce air, water, soil pollution and reduce resource consumption at the same time.

Reduce 3,700 T/year SO_2 and 600,000 m^3/ year wastewater

Annual oil consumption was reduced by 45,000 T; coal consumption by 15,000 T

INDUSTRIAL ECOLOGY IN PRACTICE

USA

- Eco-Industrial Parks (1994): Baltimore (Maryland); Cape Charles (Virginia); Brownsville (Texas); and Chattanooga (Tennessee).
- Fairfield Industrial Park (Baltimore)
  - Carbon based economy
  - Producers with processes based on petroleum and organic chemicals (e.g. asphalt manufacturing and distribution, oil and chemical companies) and smaller companies which aid the larger producers (e.g. trucking, tire retreating, and box manufacturing).
  - A great opportunity for further cycling of organic compounds.
  - Retrofit industrial ecology principles to existing companies, and recruit companies that fit into the carbon-based economy.
  - Strategy is to welcome the following types of enterprises: manufacturing that fits with the current ecology (e.g. chemical companies, film/photo companies); environmental technologies; recyclers and waste exchanges.

INDUSTRIAL ECOLOGY IN PRACTICE

Canada: Burnside Industrial Park in Dartmouth

- Converting an existing, traditional park into an industrial ecosystem
- Diversity
- A research team identified a number of strategies, guidelines, potential symbiotic relationships and support systems
- Collaboration and networking at different levels:1) the university and the municipality 2) the university, the private electric utility company and governments 3) material exchanges between two or more companies; 4) establishment of new companies to take advantage of opportunities in reuse, rental, repair, remanufacturing and recycling.
- Factors of success: an interest in eco-industrial development, a willingness to participate, and a continuing commitment by a group of partners from government, industry, academia, and community organisations.

INDUSTRIAL ECOLOGY IN PRACTICE

The Netherlands: Rotterdam Industrial Ecosystem

Mixed industries: refineries, petro chemistry, industrial services, inorganic chemistry, mass goods, storage and transport

Reuse waste streams, by-products and energy from each other.

Arnhem, Den Bosch, Apeldoorn, Utrecht have developed « industrial estates towards the concept of industrial ecosystem by seeking the opportunities to exchange energy, raw materials, and water; to facilitate the common use of utilities, combining transport of goods and people, collective collecting and treatment of waste flows

INDUSTRIAL ECOLOGY IN PRACTICE

Thailand:Map Ta Phut Eco-Industrial Park

- Gas-related and heavy industrial complex: petrochemical plants, chemical & fertiliser plants, steel plants, electricity, steam, gas plants, and oil refinery plants .
- Develops a close loop between industries to promote the clean and green industrial development concept, to maximise the benefits from utilisation of natural resources and minimise the pollution problems, and to create the co-operation among the industrial operators, the local communities and the regulators

INDUSTRIAL TRANSFORMATION IN VIETNAM: RESOURCES CONSERVATION AND MATERIAL RECYCLING

Constraints	Advantages	Recommendations
-Lack of information on quantity and quality of waste streams	- Experience of factories in HCMC and DN in waste audit	-waste audit
-Pollution relating to waste recycling units -Low quality of products produced from waste -Low market demand for recycled products	-A number of waste exchange practices exist -Benefit from available reuse/recycle techniques -Viet Nam National Cleaner Production Center (VNCPC)	-Research fund -Collaboration between VNCPC-universities-developers

INDUSTRIAL TRANSFORMATION IN VIETNAM: RESOURCES CONSERVATION AND MATERIAL RECYCLING

Constraints	Advantages	Recommendations
-Lack of recyclers in industrial zones (IZs)	-Half filled IZs -Relocation program -Existing management structure for IZs	-Integrated waste exchange-relocation program
-Lack of concrete policy -Existing price system	-Environmental Law	-Economic incentives and disincentive policies -Adjustment of price system -Workshops/seminars/ trainings -Demonstration projects

Profile

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Education:

1977-1982	Bachelor, Biology, University of Ho Chi Minh City (HCMC), Vietnam
1992-1994	Master of Sciences, Environmental Management, Asian Institute of Technology (AIT), Bangkok, Thailand
1998-2002	Ph.D., Environmental Management, Wageningen University Wageningen, The Netherlands

Research Fields/ Interests:

- Ecological Modernization Theory
- Industrial Ecology
- Public Participation in Environmental Management
- Environmental Management of Industrial Estates
- Urban Ecosystem

Selected Publications:

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Towards a Closed-loop Economy: Experiences from Zhejiang of China

Minjun Shi Ph.D.[1], HuanZheng Du[2] and Zhaodong Mao[2]

[1] Professor, School of Management, Graduate University of Chinese Academy of Sciences
[2] Professor, Jiaxing University
[3] Jiaxing University

Abstract

As Zhejiang is deficient in natural resources, the firms in Zhejiang pay great attention to retrieval and recycling of waste materials and take paths of a closed-loop economy since 1980s. The development of circular economy in Zhejiang experienced two stages: the first is recycling of waste materials and the second is efficient use of waste materials. At the stage of recycling, firms reduce production costs by recycling low-priced waste materials and cheap labor force in order to get market opportunity. At the stage of efficient use, firms increase quality of products and added valuation by improving technology in order to heighten competitiveness.

The development of circular economy in Zhejiang was initiated by firms' behavior to pursue profit. The most firms in Zhejiang are private firm. Due to private firms are difficult to get material resources through channels of planed-economy, the firms have to recycle waste materials in stead in order to ensure supply of material resources. In addition, the firms may reduce production costs by recycling waste materials. Technological innovation makes it possible for the firms to recycle waste materials. Technological innovation also plays an important role to increase quality of products at the stage of efficient use of waste materials.

The development of circular economy in Zhejiang is characterized by geographic concentration of recycling industries. As the result, a lot of industrial clusters of waste materials recycling have been formed in Zhejiang. There are several representatives, such as industrial cluster of recovery aluminum by recycling waste aluminum in Yongkang, industrial cluster of motors and sewing machine by recycling waste electric equipments in Luqiao-Wenling, industrial cluster of home electronics by recycling waste metals and waste plastic in Yuyao-Cixi. Geographic concentration of recycling industries may contribute formation of industrial chain of resource recycling and external economy of scale. It may also help the prevention of pollution in the process of recycling waste materials.

Some implications can be drawn from the experiences of circular economy in Zhejiang. Initiative of firms to pursue profit and technological possibility are indispensable to circular economy. Local government should lead firms getting together to form industrial clusters.

Towards a closed-loop Economy: Experiences from Zhejiang of China

Minjun Shi, HuanZheng Du and Zhaodong Mao

Graduate University of Chinese Academy of Sciences
Jiaxing University

Contents

- The way of circular economy in Zhejiang
- Initiative of development of circular economy
- Geographical concentration: industrial clustering
- Cases of industrial clusters of recycling waste materials
- Implications from Zhejiang experience

Highlights of Zhejiang Province

- Developed region in China
  - GDP per capita in 2004: 23,942 Yuan(10,530 Yuan at average)
- Deficient in natural resources
  - Mineral resources: 4.9% of average
  - Energy resources: 95% from other provinces
- Private economy
  - 99% of firms are private enterprises
  - It is difficult for private firms to get material resources through channels of planned-economy

The way of circular economy in Zhejiang

- Firms in Zhejiang pay great attention to retrieval and recycling of waste materials and take paths of circular economy since 1980s.
- Development of circular economy in Zhejiang experienced two stages:
  - First stage: recycling of waste materials
  - Second stage: efficient use of waste materials.

Two stages of recycling

- The stage of recycling waste materials
  - Firms recycling low-priced waste materials to ensure supply of raw materials and use cheap labor force to reduce production costs, in order to get market opportunity.
- The stage of efficient use of waste materials
  - Firms increase quality of products and added valuation by improving technology in order to heighten competitiveness.

Situation of circular economy in Zhejiang

- In 2004, recycling waste materials 18.17 MT (million ton): waste metals 8.21 MT, waste paper 6.2 MT, waste plastic 1.21 MT.
- Copper processing: In 2003, output of copper processing 1.186 MT, holds 37.12% of China; sale income 22,800 million Yuan. Waste copper material accounting for 50% of raw materials.
- Stainless steel: in 2004, output of stainless steel 1.06 MT, output of stainless steel products 1.46 MT, both hold 40% of China.

Initiative of development of circular economy in Zhejiang

- Firms' behavior to pursue profit
  - ensure supply of material resources
  - reduce production costs by recycling waste materials
- Technological innovation
  - makes it possible to recycle waste materials at the stage of resource recycling
  - increase quality of products at the stage of efficient use of waste materials

Firms' behavior to pursue profit

- Due to private firms are difficult to get material resources through channels of planned-economy, the firms have to recycle waste materials in stead in order to ensure supply of material resources.
  - Most firms in Zhejiang are private enterprise
- Firms may reduce production costs by recycling waste materials.

Geographic concentration of recycling industries

- Recycling firms of same resource or relative resources gather together spatially in a region.
  - Stainless steel: 92% of output of stainless steel and 95% of output of stainless steel products concentrate in Ningbo and Wenzhou.
    - Ningbo: In 2004, output of coiled sheet account for 49% and welding pipe 57%, 200 of firms gather together in Yuyao, Fenghua and Yinzou.
    - Wenzhou: 170 of firms gather together in Longwan district. In 2004, output of stainless steel 215,000 ton, stainless steel products 55,000 ton. Output of seamless stainless pipe 207,500 ton, account for 90% of the nation, export of seamless stainless pipe account for 50% of the nation.
  - Waste copper: over 60% of waste copper recycling in Ningbo concentrate in Cicheng town of Jiangbei and Jinghan town of Cixi.; over 80% of waste copper recycling in Shaoxing concentrate in Diankou town of Zhuji and Tangpu town of Shangyu; over 80% of waste copper recycling in Jinhua concenterate in Zhiying town of Yongkong.
  - Waste plastic: waste plastic recycling concentrate in Dongyang, Cixi and Taizhou.
    - Dongyang: Firms gather together in Huaxi town. There are more than 1500 of firms, and 50 thousand people of employee.

Clustering

- A lot of industrial clusters of waste materials recycling have been formed in Zhejiang.
- Geographic concentration of recycling industries may contribute formation of industrial chain of resource recycling and external economy of scale.
- Clustering may help the prevention of pollution in the process of recycling waste materials.

Case of industrial cluster of recycling waste metal in Yuyao

- In Hemudu town of Yuyao, there are 110 of stainless steel firms. Processing capacity 250,000 ton
- Production value of stainless steel account for 80% of total production of the region
- Output of top grade stainless steel board produced by the Baoxin company account for a market share of 10%

Case of industrial cluster of recycling waste aluminum in Yongkang

- Firms of recycling waste aluminum: more than 1000 firms
- Recycling waste aluminum one year: 250MT
- The maximal production base of recovery aluminum and products in China

Case of industrial cluster of recycling waste electric equipments in Luqiao

- Industrial park of metal recycling at Fengjiang town of Luqiao
- 106 ha, total investment 620 million Yuan
- 40 of firms gathered together
- Disassembly capability: 2 MT
- Industrial park contributed to solve secondary pollution come from disassembly process.

Case of industrial cluster of recycling waste plastic in Cixi

- Recovery terylene fibre: 30 of firms and 20 thousands people of employee
- Annual output of recovery terylene fibre 700,000 ton, annual sale income 5000 million Yuan, account for 25% of the nation.
- All of raw materials are waste silk or bottle of coca cola. 30-40% of raw materials come from domestic and the rest imported.

Case of industrial cluster of paper mills in Fuyang

- In 2004, waste paper recycled by paper mills in Fuyang reached 4 MT, account for 10% of total quantity of waste paper in China
- Annual output of chipboard paper and account for 50% of Zhejiang province
- Production value of paper making 8500 million Yuan, account for 20% of total industry product in Fuyang

Implications from Zhejiang experience

- Initiative of firms to pursue profit and technological possibility are indispensable towards a closed-loop economy.
  - Circular economy should be profitable for the firms.
- Clustering may conduce formation of industrial chain of resource recycling and help prevention of secondary pollution in the process of recycling waste materials.
  - Local government should lead firms gathering together to form industrial clusters.

Profile

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Education:

1979-1983	B.Sc., Department of Geography, Zhejiang University
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Professional Career:

1983-1989	Government Officer, Xinchang county, Zhejiang Province, China
1989-1996	Research fellow, Commission for Integrated Survey of Natural Resources, Chinese Academy of Sciences
1996-1999	Assistant Professor, Institute of Agriculture and Forestry, University of Tsukuba, Japan
1999-2005	Associate Professor, Institute of Agriculture and Forestry, University of Tsukuba, Japan
2005-	Professor, Graduate University of Chinese Academy of Sciences
2005-	Executive Dean, College of Resource and Environment, GUCAS
2006-	Professor, School of Management, GUCAS
2001-	Visiting Professor, Department of Rural Economy, University of Alberta, Canada
2001-	Adjunct Research Professor, Institute of Geographical Science and Resource, Chinese Academy of Sciences
2002-	Adjunct Professor, Center of Agriculture and Rural Development, Zhejiang University
2003-	Adjunct Research Professor, Institute of Soil and Water Conversation, Chinese Academy of Sciences
2006-	Adjunct Professor, Henan University

Research Fields/ Interests:

(1) Sustainable Resource Management and Regional Development for Combating Land Degradation and Promoting Circular Economy
(2) Spatial Economic Process and Regional Development Policy
(3) Agricultural Industrialization and Agri-food Supply Chain Management, Competitiveness of Agri-food Industry

Committee/ Boards:

- International Association for Agricultural Economists (IAAE)
- The Agricultural Economics Society of Japan
- Japan Section of the Regional Science Association International (JSRSAI)
- The Food system Research Association of Japan
- The Japanese Society of Regional and Agricultural Development
- Chinese Association of Natural Resource Research
- The Regional Science Association International (RSAI)

Selected Publications:

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Key Obstacles to Establishing Sustainable Agriculture and Environments

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Abstract

Presently, agriculture in Japan faces many difficulties: the continually rising price of petroleum has lead to increased farming costs in the form of more expensive agricultural machinery, pesticides and fertilizer. Long-term pollution by residual pesticides also disrupts safe food production.

Furthermore, the movement towards international free trade (via the WTO) has made the cost-benefit balance so deleterious for Japanese farmers that many now must rely on farm subsidies from the Japanese Government to survive.

A more serious problem is that of aging farming communities. Although many retired urban dwellers continue to move to rural areas to work on farms as a lifestyle change, this trend is basically disrupted by private management allodial tenure systems. Under such circumstances, we may suppose several additional agricultural difficulties brought about by global warming: Changes in pest fauna may cause sudden pest outbreaks, due to the expected time delays until natural enemies can adapt.

A decrease in the variety of pesticides due to food and environment safety requirements may also make future pest control difficult. How to control alien pests? A shortage of (petroleum-based) energy for agricultural implements and machinery may also exacerbate the problem. How can we decrease our strong dependence upon petroleum?

There is no need to say that we cannot survive without the food produced from agriculture, and it is very apparent that we cannot continue importing most of our food from other counties indefinitely. Therefore, we are now beginning to establish a new type of agriculture that can overcome the present as well as expected future difficulties.

Rising to the challenge these problems pose, we at Hokkaido University's SGP have started the integration of various scientific activities/fields, which have until now have usually been conducted separately. I will address previous attempts and those that are now underway in Hokkaido University's SGP.

How to establish sustainable agriculture

Key Obstacles to Establishing Sustainable Agriculture and Environments

Yutaka Saito
Deputy-Director of SGP
Professor of Hokkaido University

1

What is sustainability?

•Agriculture in Japan was maintained in a sustainable way up until approximately 140 years ago (end of the Edo Period).

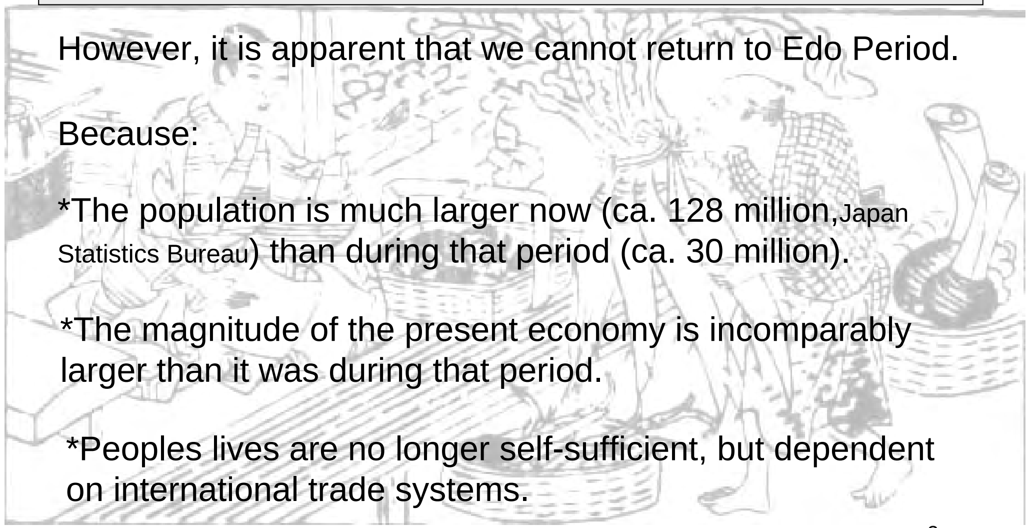
•Hokkaido University was a pioneer of modern agriculture in Japan after that period.

•In other words, we and our foregoers have made both Hokkaido and Japanese agriculture unsustainable in order to achieve higher food productivity .

•Because politicians strive for the short-term affluence of the people, this history is inevitable.

2

During the Edo Period (1603-1867) Japan was basically maintained as a self-sufficient society via its policy of self-seclusion



However, it is apparent that we cannot return to Edo Period.

Because:

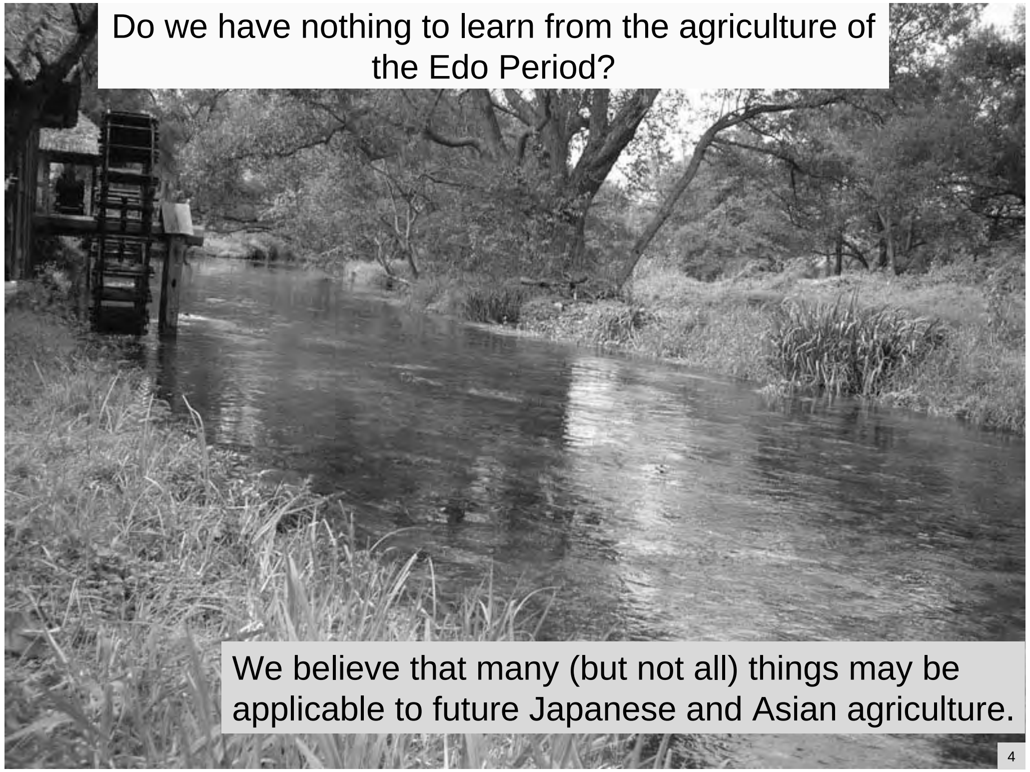
*The population is much larger now (ca. 128 million,Japan Statistics Bureau) than during that period (ca. 30 million).

*The magnitude of the present economy is incomparably larger than it was during that period.

*Peoples lives are no longer self-sufficient, but dependent on international trade systems.

3

Do we have nothing to learn from the agriculture of the Edo Period?



We believe that many (but not all) things may be applicable to future Japanese and Asian agriculture.

4

What do we have to do now and in the future?

Problems are as follows:

*Japanese agriculture has ceased being an economically viable industry, due to the large-scale importation of cheaper food and the rising price of agricultural chemicals.

*Aging of agricultural workforce is an extremely serious matter.

*Over-investment in chemical fertilizers and pesticides, polluted environments, soils and food products themselves.

5

From a world-wide perspective food is in chronic short supply.

Integration of agricultural activities is the key

How we can resolve such a serious absurdity?

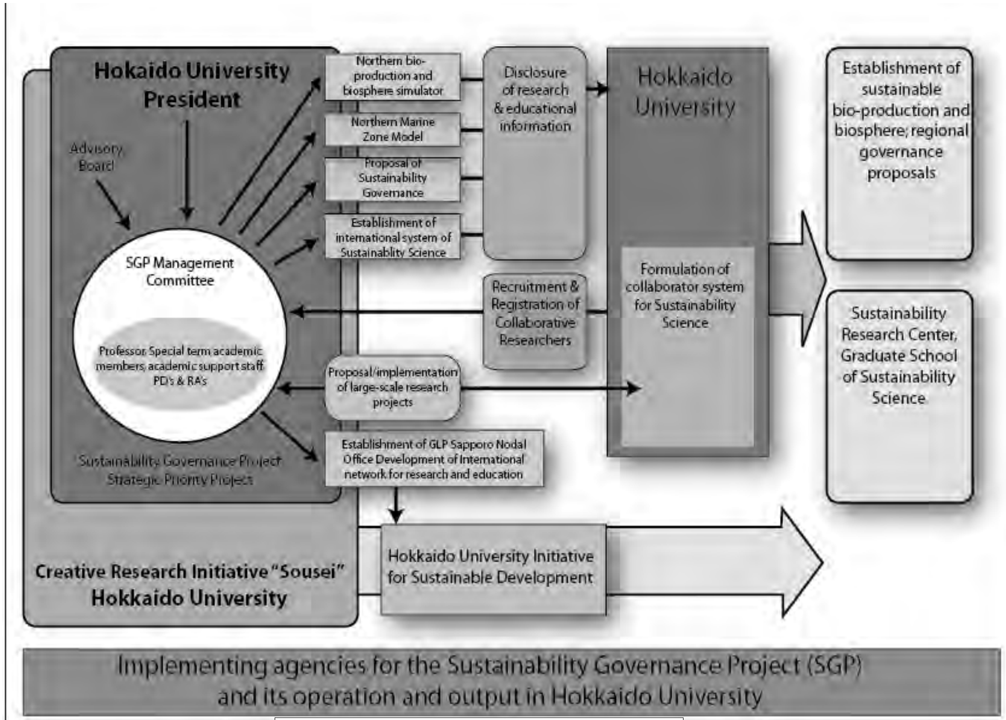
The Sustainability Governance Project (SGP) in Hokkaido University will challenge this problem through environmental and agricultural sciences, economics and law.

6

Sustainability Governance Project (SGP) in Hokkaido University

INTEGRATED RESEARCH SYSTEM FOR SUSTAINABILITY SCIENCE (IR3S)

7



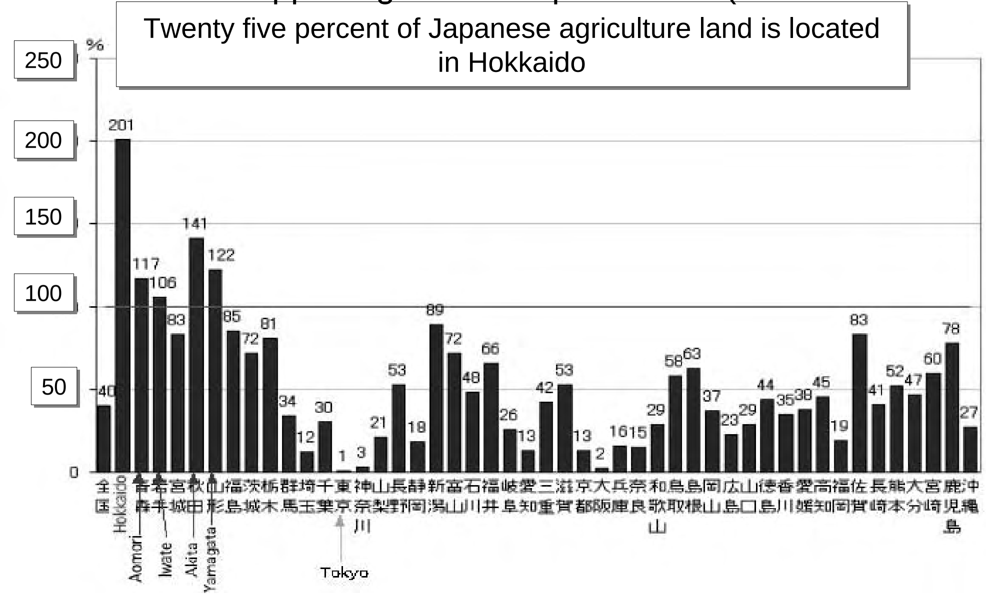
Organization of the SGP

8

Prtoject of northern bio-production and biosphere simulator will address "sustainable agriculture" in Hokkaido and northern Asia.

9

Food self-supporting ratio in Japan = 39% (based on calories)

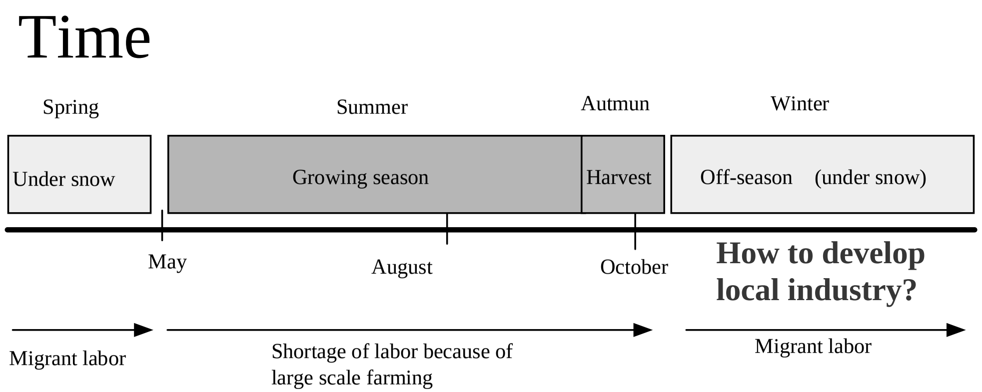


Food self-supporting ratio based of calories.
Comparisons between prefectures in Japan (2004, from http://www2.ttcn.ne.jp/~honkawa/7235.html)

10

Local problems:

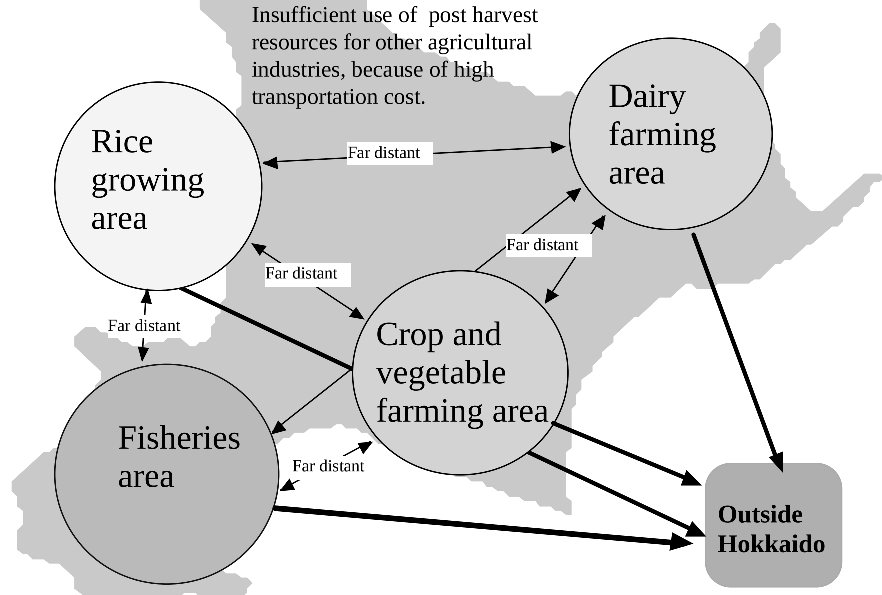
Hokkaido Agriculture - Weak Point 1



There is a temporal inconsistency for labor demand in Hokkaido agriculture (rice, potato and vegetable growers) other than dairy farmers.

11

Hokkaido Agriculture - Weak Point 2 = Spatial distribution



There is only one big consumption city, Sapporo, in Hokkaido, such that most products must be transported to the other big cities located far from production areas.

12

How to solve these problems is a key theme of SGP, because:

Self-sustainable agriculture will be urgently required,
Due to expected increases in transportation costs
And decreasing prices for agricultural commodities.

Effective use, re-cycling and re-use of bio-products are keys to sustainability, because bio-products are important sources of "non-greenhouse gas" energy.

Integration of agricultural activities is the way to establish sustainable systems

13

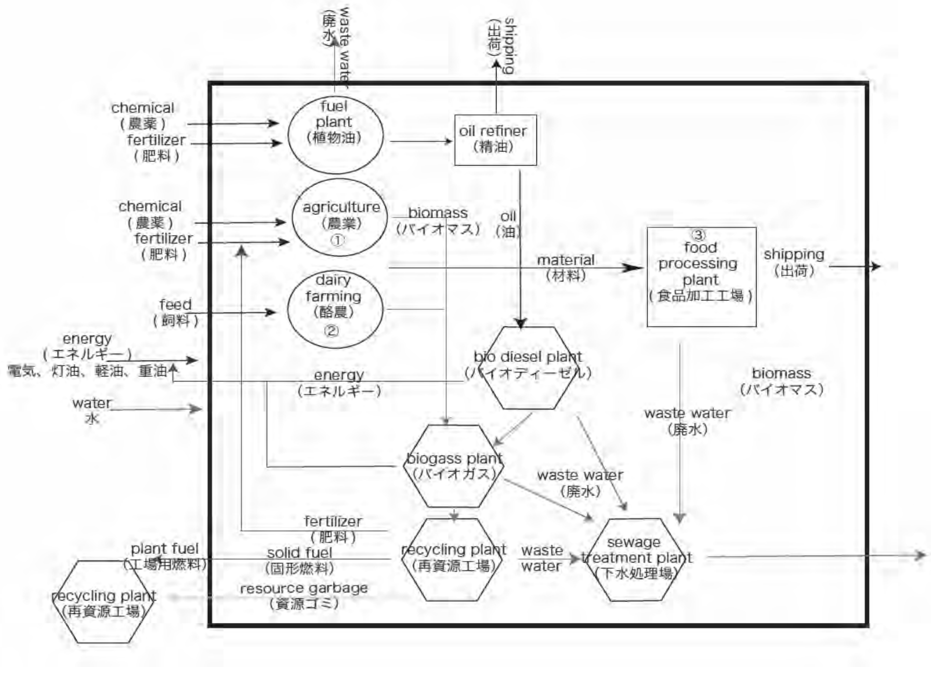
Case study for SGP in agricultural fields

(Northern Biomass Simulator-Working Group)

•The target ---> the small rural city of Furano (population ca. 20,000) where recycling operations are well-established.

1. Description of the city's activities - especially for agricultural - using a systems simulation approach.
2. Search of non-rational activities and relationships in the system.
3. Ideas for re-constructing the city industry systems will be proposed to citizens and local government.
4. Re-construct Furano as a sustainable rural city where citizens are comfortable and industries are sustainably and rationally controlled.

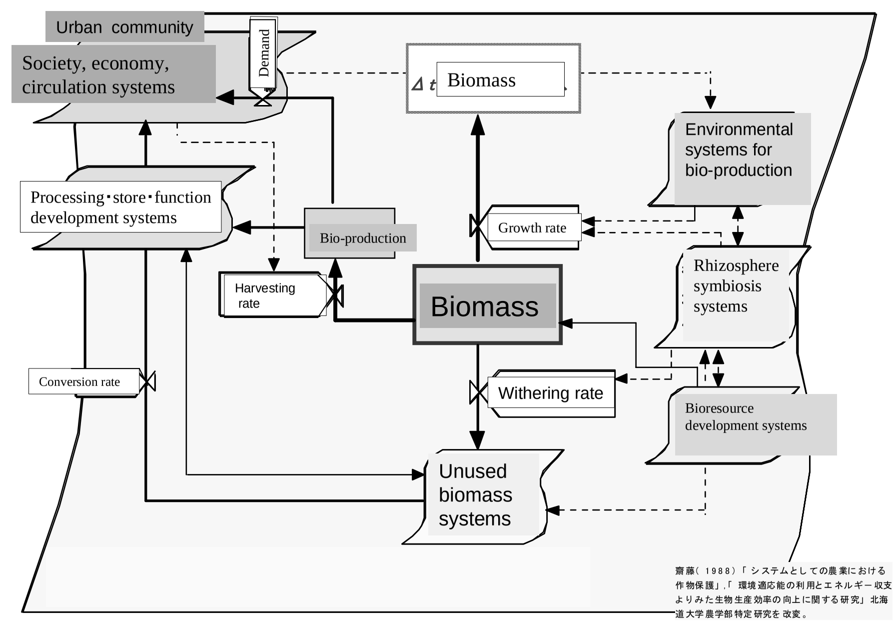
14



Systems flow diagram of Furano city

15

Systems simulation (dynamic model) for bio-production industry in Hokkaido



齋藤（1988）「システムとしての農業における作物保護」,「環境適応能の利用とエネルギー収支よりみた生物生産効率の向上に関する研究」北海道大学農学部特定研究を改変。

16

Global warming must cause drastic change in agriculture.

Many believe that such a change may be advantageous for the Hokkaido region where cold weather conditions severely restrict agriculture (i.e. cold-weather damage).

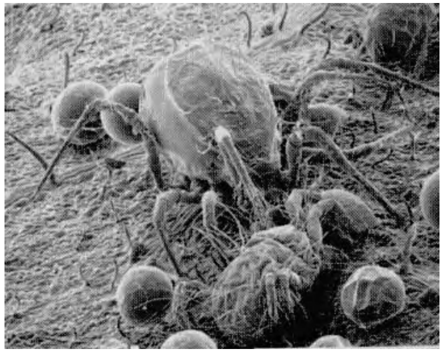
Is that's true?

As entomologists, we believe global warming poses a greater threat in the form of unexpected outbreaks of pests and disease.

As we know, agricultural pests generally have a high potential for population increase and high adaptability to new environments. On the other hand, natural enemies do not always have the same flexibility to adapt to drastic climate changes. We have to expect some delay until stable interactions can be established in agro-ecosystems.

17

17



Pest management as an important element in achieving sustainable agriculture,

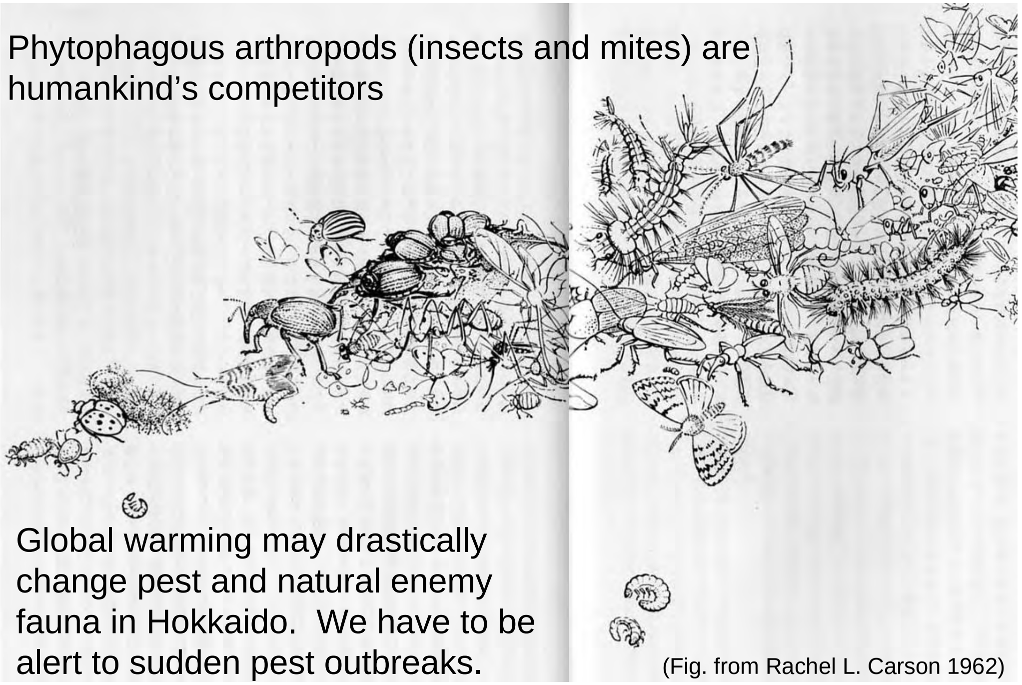
because US$1,500 million spent for pesticides in Japan every year (data in 2001).

From the view of safety and sustainable agriculture, the introduction of IPM (Integrated Pest Management) should be considered, in order to decrease the use of pesticides and other chemical compounds.

Hereafter, I will address several fascinating IPM examples. 18

18

Phytophagous arthropods (insects and mites) are humankind's competitors



Global warming may drastically change pest and natural enemy fauna in Hokkaido. We have to be alert to sudden pest outbreaks.

(Fig. from Rachel L. Carson 1962)

19

19

An example of biological control (BC in IPM) in Africa and Latin America

Cassava Green Mite

The Cassava Green Mite (CGM) is a pest responsible for between 30 and 50 percent yield loss of cassava, a starchy root crop in tropical Africa. Cassava is a staple food for more than 200 million people in sub-Saharan Africa. As it is rich in calories, highly drought tolerant, thrives in poor soils and is easy to store in the ground, cassava is popularly called "the staff of life" for the poorest of the poor in Africa.

"the new breakthrough in CGM control through the use of predatory mites constitutes another milestone in the classical biological control of crop pests"

20

20

International joint researches have been carried out

The project involved international agricultural research centers in Africa and Latin America, national agricultural research systems, and farmers in a joint effort to develop an ecologically sustainable cassava plant protection strategy. Under the arrangement, IITA is collaborating with the International Center for Tropical Agriculture (CIAT), in Cali, Colombia, the Brazilian Agricultural Research Corporation (EMBRAPA) in Brazil, and several African national research systems.

The United Nations Development Programme provided four-years funding for this project to help scientists at the centers and in national institutions in four West African countries (Benin, Cameroon, Ghana and Nigeria) to work directly with farmers and extension agents.

The Predatory mite, Typhlodromus aripo was discovered to be quite effective natural enemy of CGM.

After its introduction to the Africa's cassava belt in 1993, *Typhlodromus aripo* found a conducive environment to prey on CGM. Impact assessment studies carried out by IITA at the sites where the CGM natural enemies had been released revealed that cassava yields increased by 35 percent within one season. Farmers can gain up to 70 US Dollars per hectare of cassava planted. In West Africa alone this adds up to a total profit per planting season of about $60 million for the cassava farmers.

(*International Institute of Tropical Agriculture (IITA)/Centro Internacional de Agricultura Tropical (CIAT)*)

22

22

An Asian IPM example.

China-Japan joint research on IPM in bamboo forests and biological control of pest mites in China.

ZHANG YAN-XUAN & LIN JIAN-ZHEN
Insititute of Plant Plotection, Fujian Academy of Agricultural Sciences, China

ZHANG ZHI-QIANG
Landcare Research, New Zealand

SAITO YUTAKA & A.R.CHITTENDEN, Lab. Animal Ecolog, SGP Hokkaido University
SAHARA KEN, Lab. Applied Molecular Entomology, Hokkaido University, Japan
OHSAKI NAOTA, Lab. Ecological Entomology, Kyoto University, Japan

Outbreaks of pest mites on Moso bamboo have occurred since the late '80, and many bamboo forests have been withered in southern China.

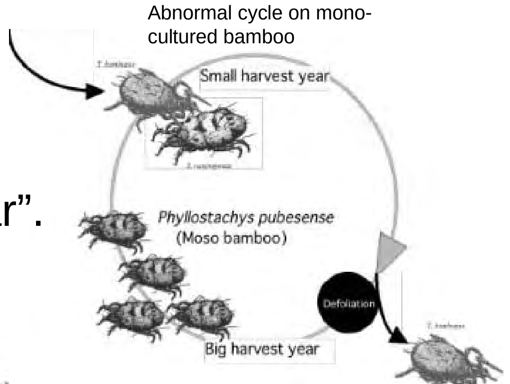
23

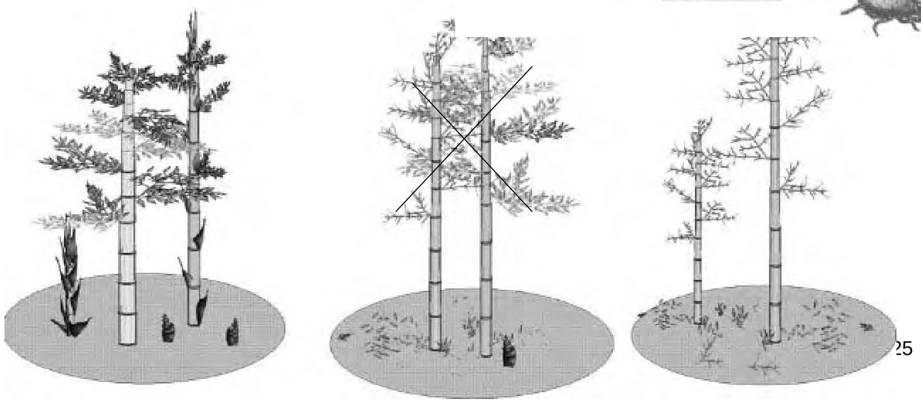
23

Damage to Moso Bamboo in Fujian province (Photo by Dr. Zhang Yan-Xuan, 1989)

24

There are few natural enemies in damaged bamboo plantations especially in a “big year”.





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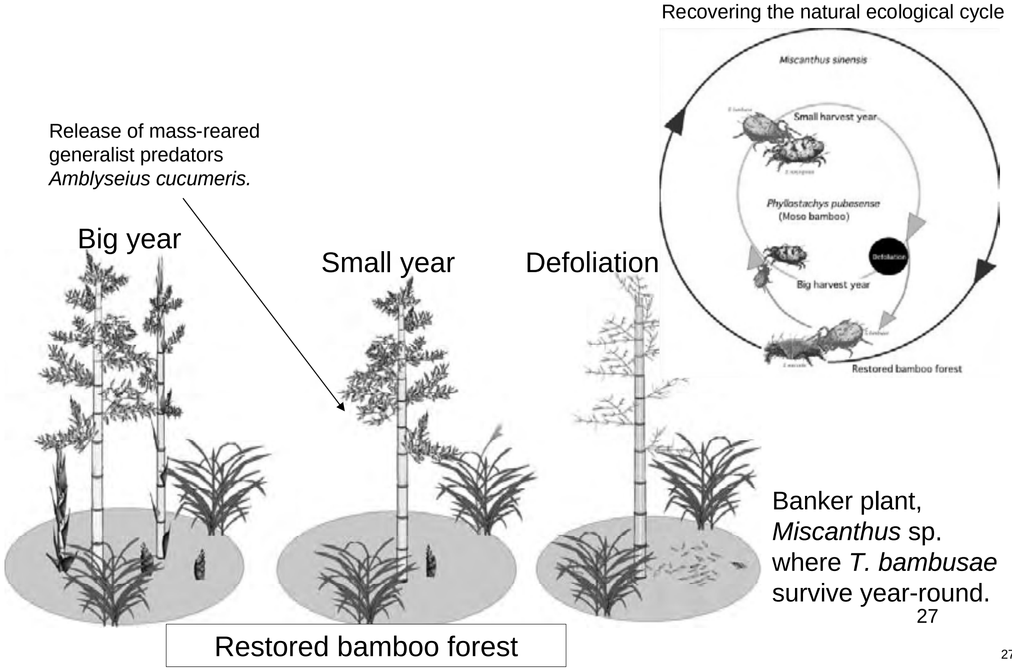
25

It is known that the pest outbreaks on bamboo were triggered by a change from polyculture to monoculture bamboo cultivation, which inevitably decreased arthropod (pests and their natural enemies) diversity.

The joint survey revealed that *Typhlodromus bambusae* is the most important predatory mite in the Moso bamboo forests in Fujian province, China.
Furthermore, an introduced predator species, *Amblyseius cucumeris* also provides effective control of pest mites and several small insect pests.

26

An example of restoring damaged Fujian bamboo forests through biodiversity.



27

27

Mass-reared *Amblyseius cucumeris* (predacious mite) have become established as commercially successful biological control agents in China.

Mango plantation in Xianmen, China

28

An extra:

On the other hand, Moso bamboo has destroyed traditional Japanese forests, Sato-yama

Poorly maintained bamboo forests often trigger landslides.
Cheaper imported bamboo shoots suppress efforts to maintain Japanese bamboo forests.

29

29

Thus there is a conflict between Chinese and Japanese bamboo plantations.

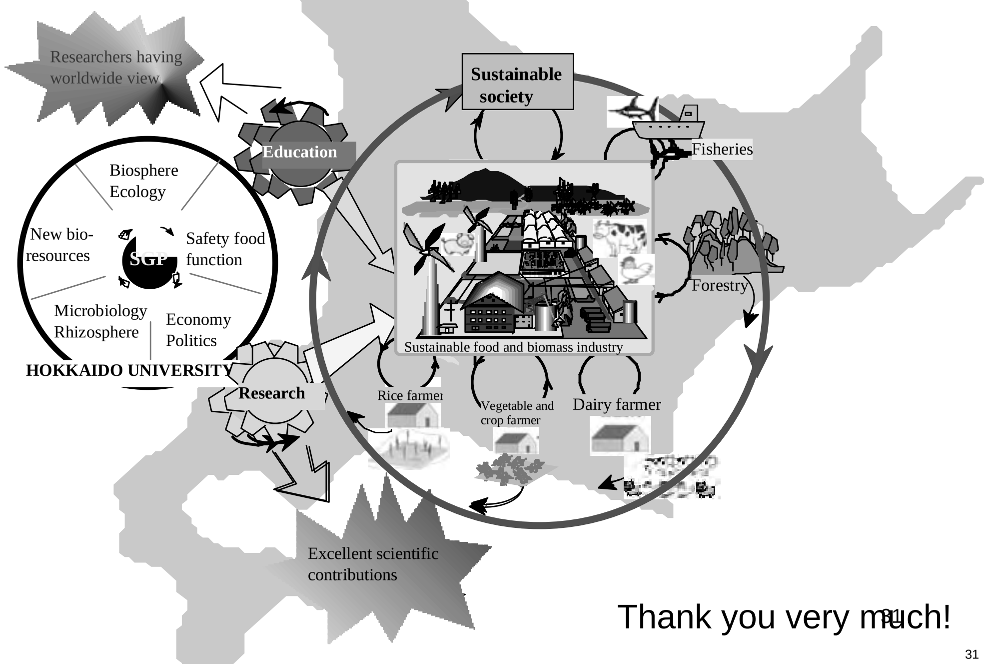
We have learned that the establishment of sustainable agriculture in one country can sometimes cause unexpected problems for sustainability in another country.

This is only a small example, but we must pay attention and be prepared for such possibilities.

30

30

Conclusion: Integration of agricultural activities is the key

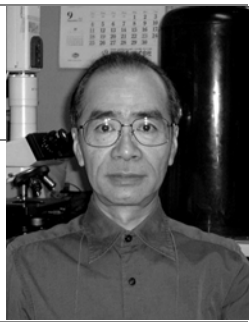


Thank you very much!

31

31

Profile



Name Yutaka Saito, Ph.D.

Affiliation Professor, Research Institute of Agriculture, Hokkaido University
Deputy Director of Hokkaido University Sustainability Governance Project

Education:

1972	B.A., Hokkaido University (Agricultural Biology)
1974	M.A., Hokkaido University (Agricultural Biology
1978	Ph.D., Hokkaido University (Agricultural Biology)

Professional Career:

1981 -1993	Assistant Professor, Faculty of Agriculture, Hokkaido University
1993- 1996	Associate Professor, Faculty of Agriculture, Hokkaido University
1996-Present	Professor, Graduate School of Agriculture, Hokkaido University

Research Fields/ Interests:

Biological pest management is still woefully insufficient in Japan, despite priority-level recommendations from more and more governments around the world. Implementation costs and the old-fashioned production systems used by small-scale farmers are the main reasons why such safe technology is proving difficult to introduce into Japanese agriculture. As such, I will try to idealize how to transform the status quo into systems that utilize safe biological pest management, natural fertilizers and the like, to achieve rational biomass production, and in turn develop new, sustainable agricultural systems applicable to Japan as well as to the rest of Asia. For such purposes, I have studied on utilizing fundamental ecology to develop new methods of controlling plant pests biologically, on permanent biological control systems in the Moso bamboo plantations of Fujian, China, and development of a simulation model of natural enemy-pest systems in agricultural fields.

What does Sustainability mean to Yuhan-Kimberly?

Ahn JoongWoo Ph.D. [1], KiWook Song[2], KyungShin Kim[2], JiYeon Ahn[2]
[1] Sr. Director of Sustainable Management, Yuhan-Kimberly
[2] Yuhan-Kimberly

Abstract

Yuhan-Kimberly, one of the leading consumer product companies in Korea, enjoys the best in its class by continuous introduction of many innovative products into the market for more than 30 years. As a result, the outstanding market shares are achieved in all involving categories ranging from 50% to 70% or above. In addition, the company has been selected as the Top 10 Best Employer in Asia, Korea Most Admired Company, Most Environment-Friendly Company Award and so on for the last decade. This success can be ascribed to the leadership efforts in such fields as Environmental Management, Ethical Management and now Sustainable Management in Korea.

What does Sustainability mean to Yuhan-Kimberly? It is the Company's belief that a sustainable company should be sustainable together with 4 external customers: the Earth, the Market, the Communities and the Supply Chains. The presentation illustrates what Yuhan-Kimberly has done for sustainability with these 4 customers and introduces what the outcomes are when sustainability tools are properly applied such as Cleaner Production, Environmental Management System, Eco-Labeling, Eco-Design, Life Cycle Assessment, Environmental Reporting, and Supply Chain Environmental Management. This also shows how Yuhan-Kimberly can crystallize Sustainability into doable and harmonized action steps without losing consistency throughout the Company operation.

Sustainability Science in Asia

A Practical Case of Yuhan-Kimberly

Ahn, Joong Woo, Ph. D.
Sustainable Management
Yuhan-Kimberly
Nov, 22, 2006

1

Company Profile

Incorporation	March 30, 1970
Ownership	Yuhan + Kimberly-Clark
Total sales	$ 740 MM in 2005
Business Area	• Personal Care Products • Household Products • Industrial Products • Health Care Products • Digital Textile Printing Solutions

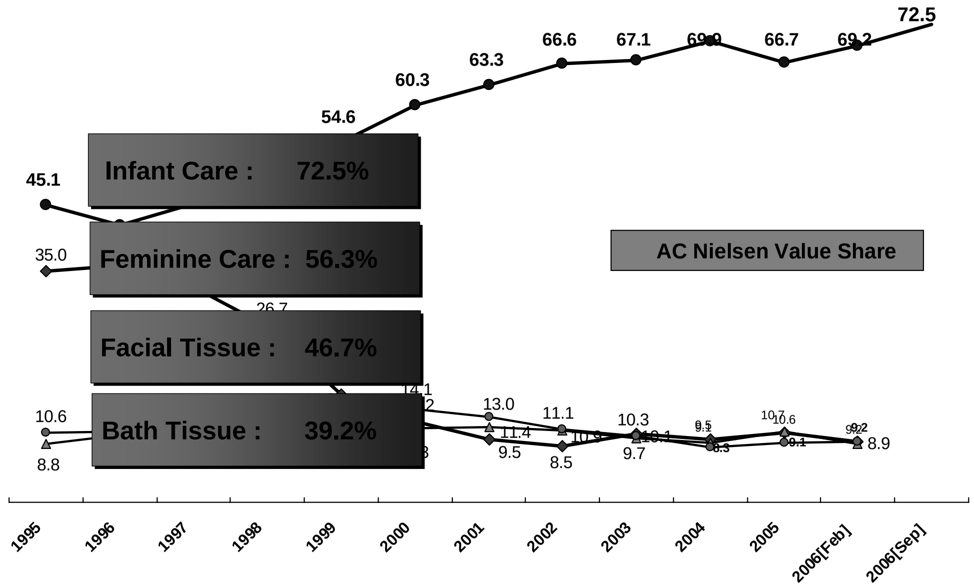
2

Reputation of Y-K

- Market Share
  - No.1 in All Categories Involved (AC Nielsen, 2006)
- >Best Employer
  - Top.10 (Hewitt Associates, 2003)
- Environmental Management
  - No.1 (Mail Economics Daily, 2003)
- Admired Company
  - No.1 (IBM BCS/Dong-A, 2005)

3

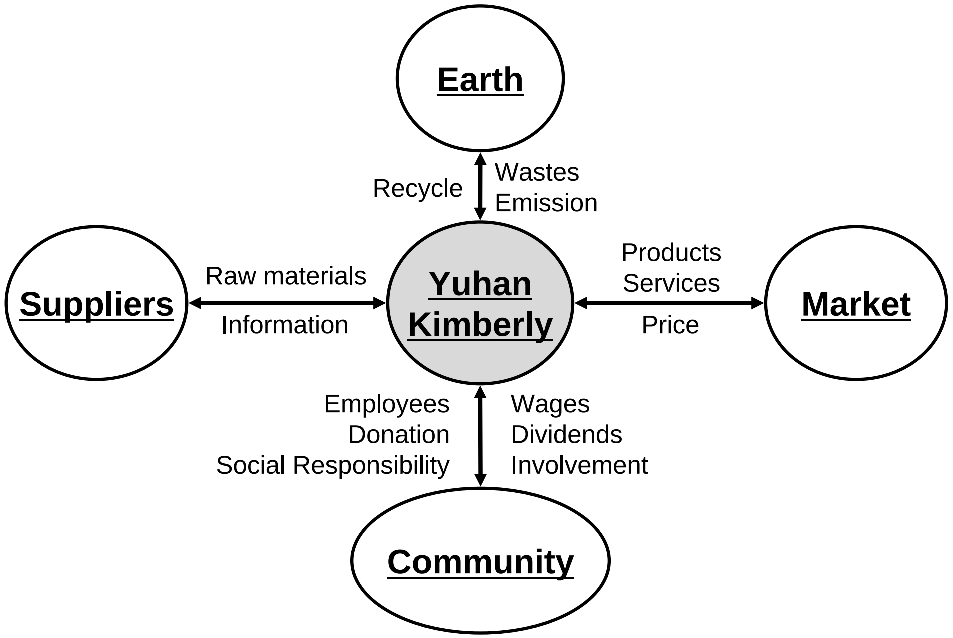
Market Share Trend



No.1 in All Categories Involved

4

New Paradigm - Sustainability



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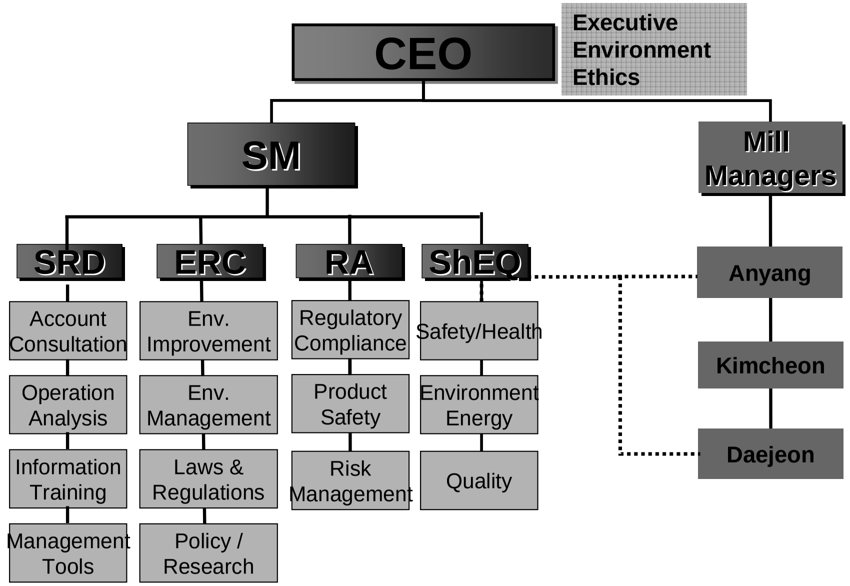
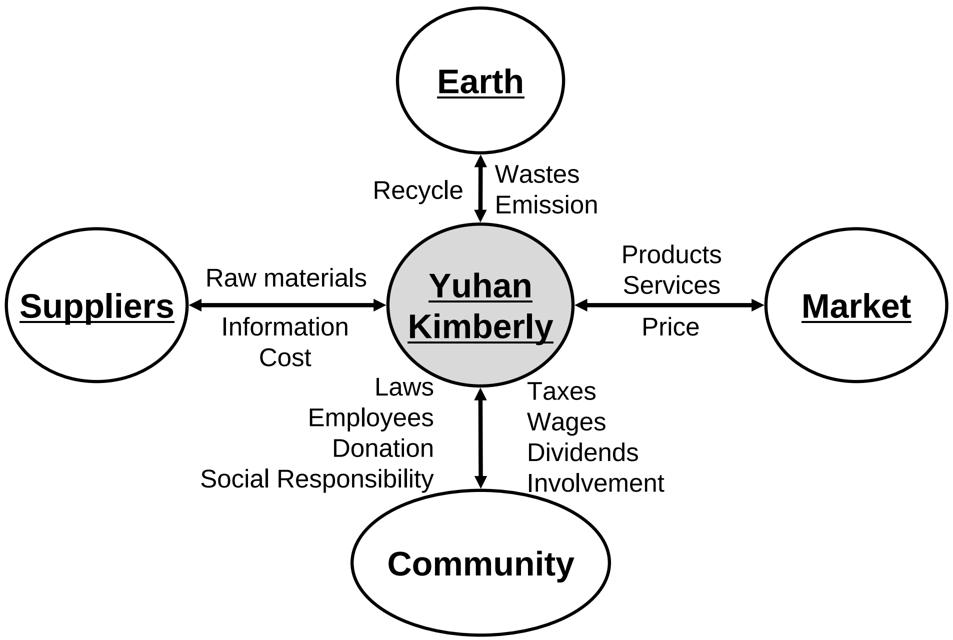
Multi-Dimensional Organization



SRD: Supplier Relations Development
ERC: Environmental Research Center
RA: Regulatory Affairs
ShEQ: Safety, health, Environment, Quality

6

New Paradigm - Sustainability



7

Earth
Environmental Policy for Sustainability

- Compliance with Environmental Law and Company Regulation

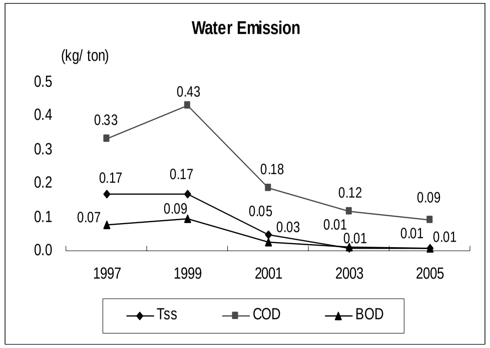
- No. 1 Priority in Source Reduction of the Contaminants

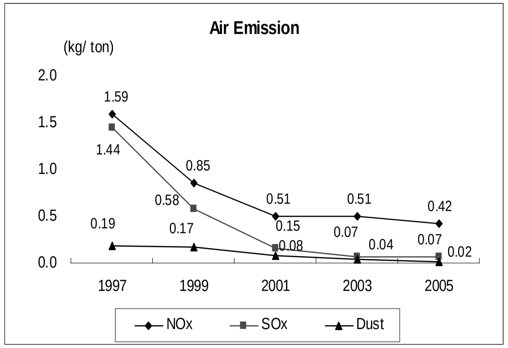
- Continuous Improvement through Life Cycle Assessment

- Accident Prevention through Risk Assessment

8

Earth's Bio & Lithosphere
Environmental Performance
- Water & Air Emission -





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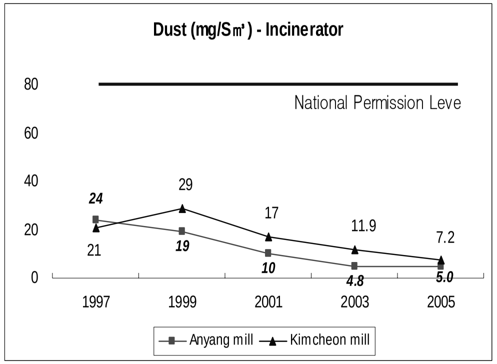
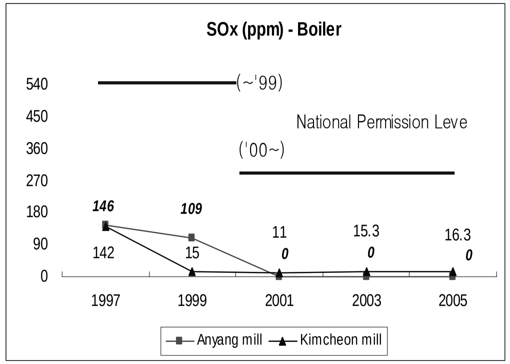
Earth's Bio & Lithosphere
Environmental Performance
- Dust & SOx Emission -





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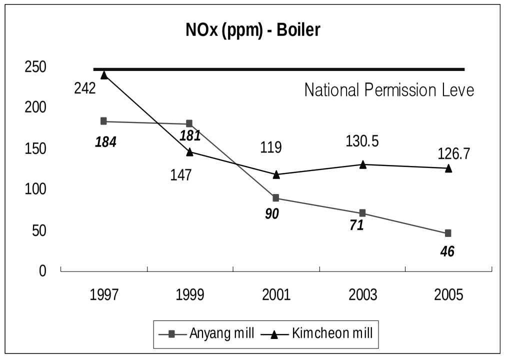
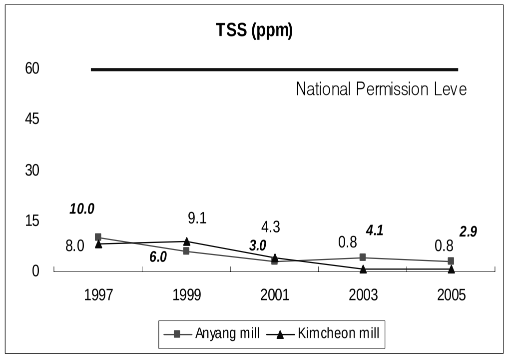
Earth's Bio & Lithosphere
Environmental Performance
- NOx & TSS Emission -





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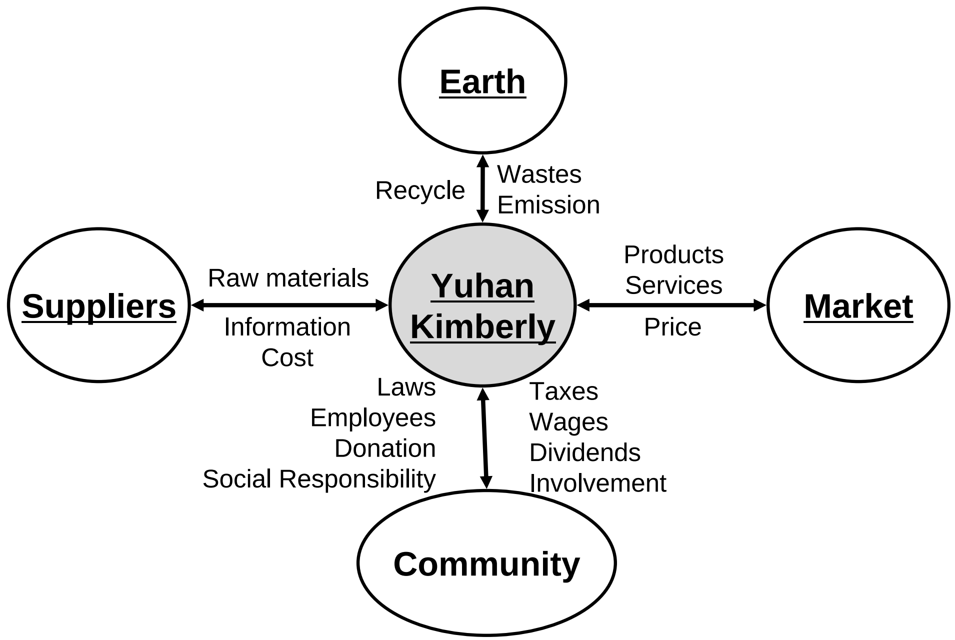
New Paradigm - Sustainability



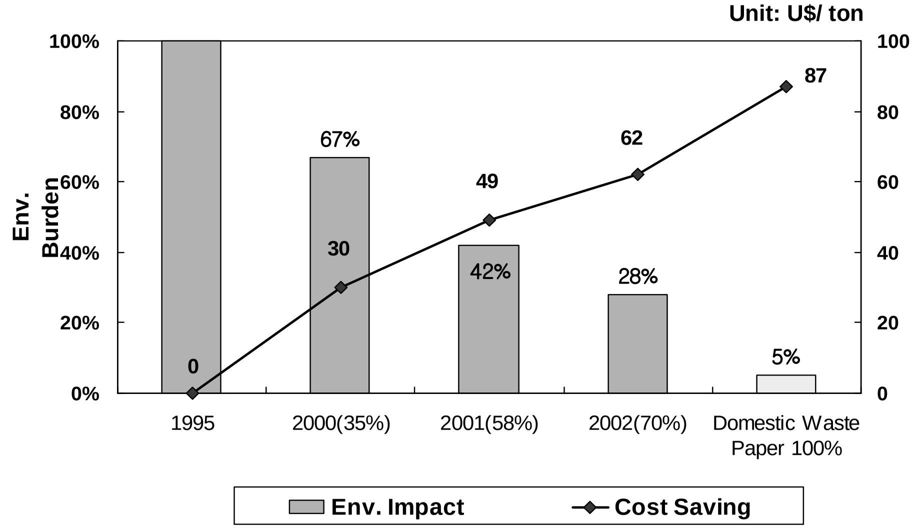
12

Market
Products / Services

- **Life Cycle Assessment (ISO 14040)**
  - Bathroom Tissue '01
  - Digital Textile Printing '03
  - Incineration '04
  - Contract Manufactured Non-Woven '04
- **Environmental Labeling (ISO 14020)**
  - "Popee Plus" Bathroom Tissue '02

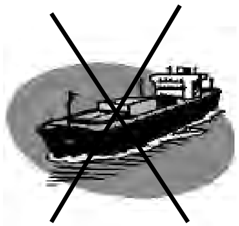
13

Market
Sourcing Change in Recycled Paper
from Import to domestic

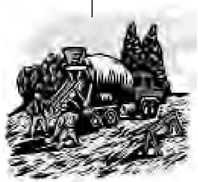


14

Market
Sourcing Change in Recycled Paper
Imported → Domestic



Benefit



- Cost Saving $ 1.1 Million/year

- Promoting Recycling of Domestic Waste Paper & Job Creation

15

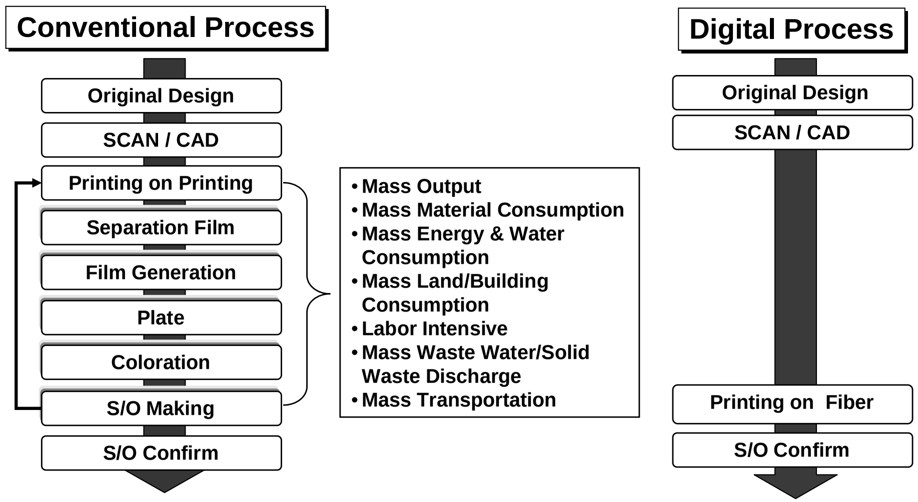
Eco-efficient Process : Digital Textile Printing

Conventional Process

Digital Process

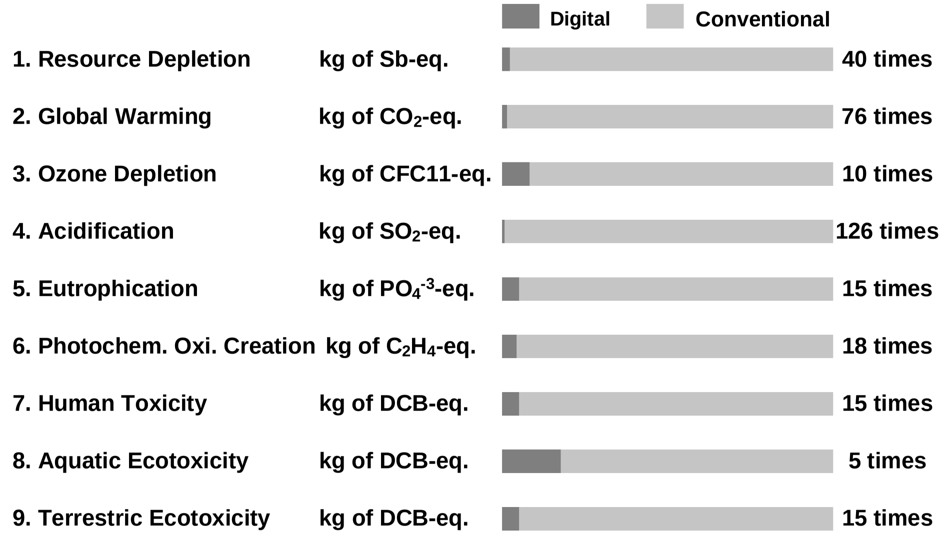
16

Eco-efficient Process : Digital Textile Printing

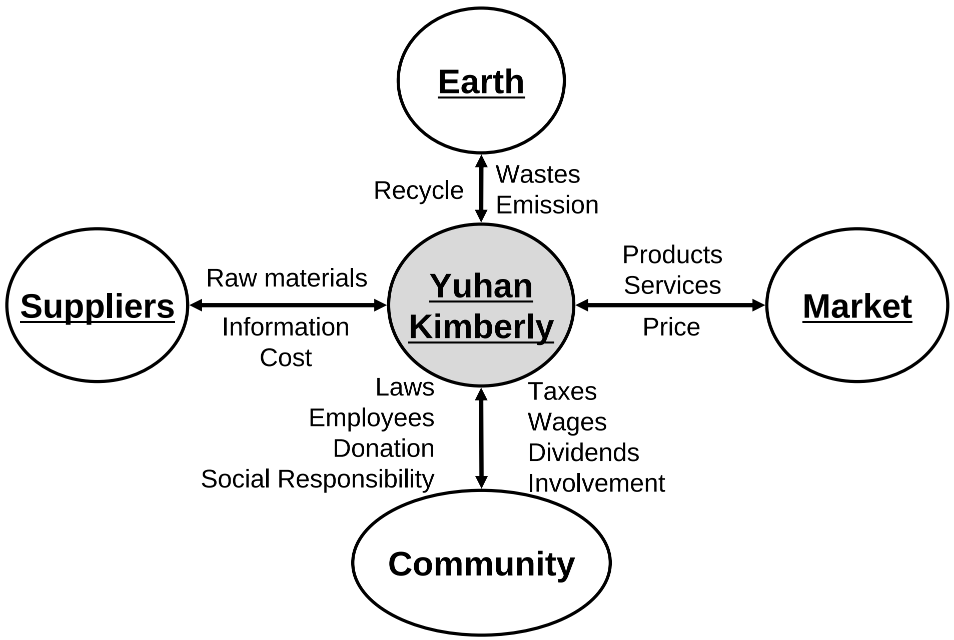


17

Result of LCA : Digital vs. Conventional

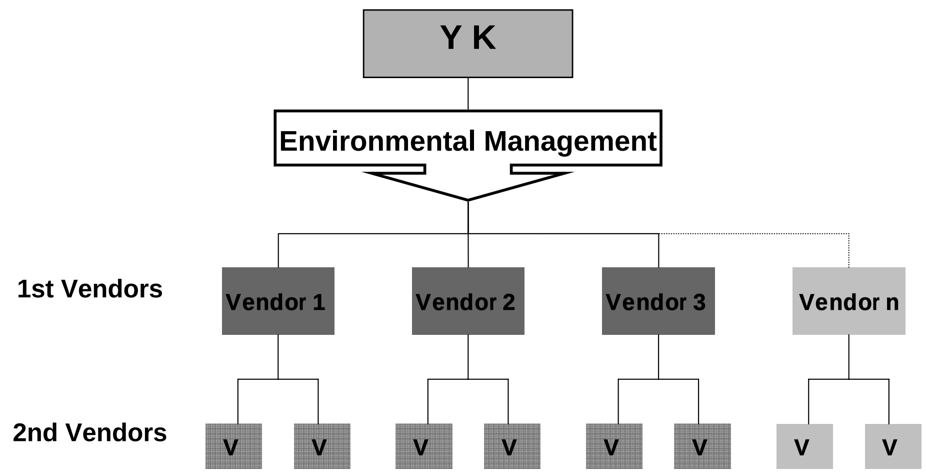


New Paradigm - Sustainability



19

Suppliers
Supply Chain Environmental System



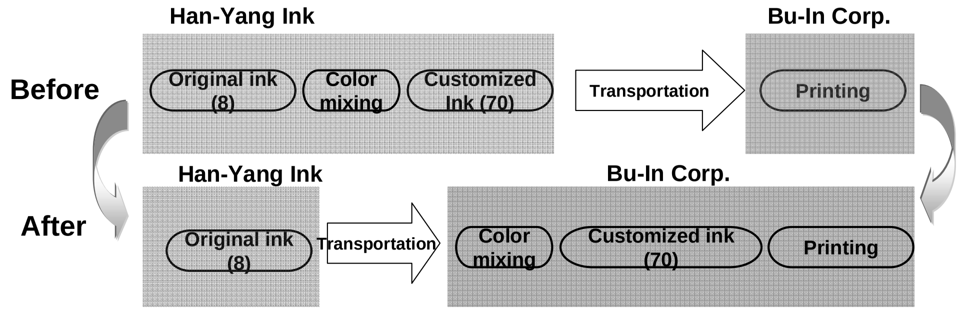
20

Suppliers
Supply Chain Environmental System

	EMS	LCA	EPE	REPORT	EA
Hanjin		○	○	○	○
Aju		○	○	○	
Dongwoo	○		○	○	
Buin	○	○	○	○	○
Yujin	○		○	○	
Handok	○		○	○	
Asan	○		○	○	
PTL	○		○	○	
Care		○	○	○	
Bylin		○	○	○	
Dongin	○	○	○	○	
Daemyung	○	○	○	○	
Kimbelry	○		○	○	
Woopoong	○				

21

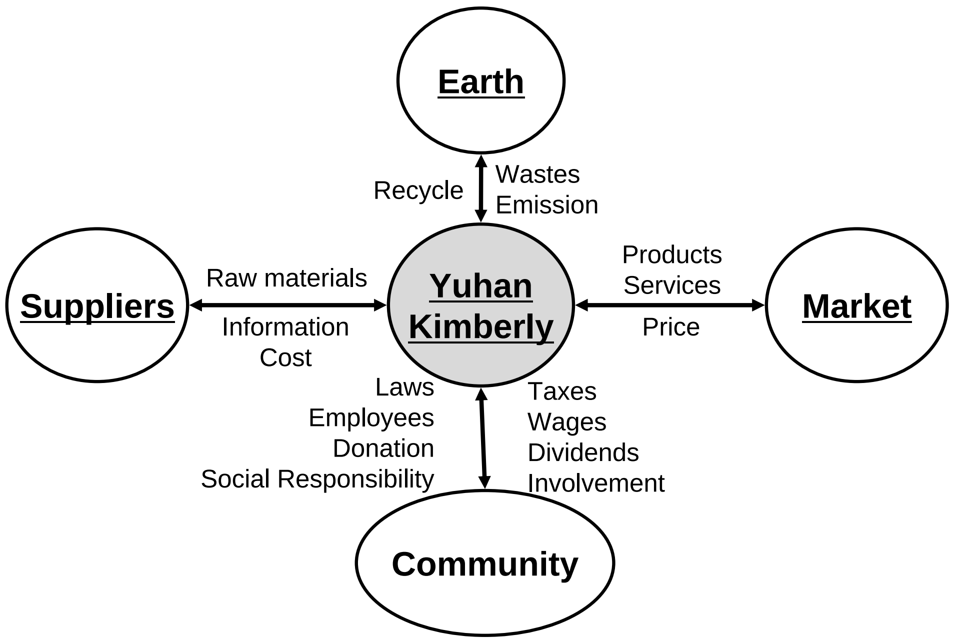
Suppliers
Supply Chain Cleaner Production



2nd Supplier (Han-Yang Ink)	1st Supplier (Bu-In Corp.)
- Productivity Improvement - Stock Reduction: 400~500 kg - Transport Charge : 5 times/week → 2 times/week	- Quality Improvement - Stock Reduction : 800 kg→400 kg - Technology Improvement

22

New Paradigm - Sustainability



23

Community
Keep Korea Green

- **Foundation:** 1984
- **Budget/yr:** **1.3%~1.5% Net Sales**
- **Activities**
  - **- Afforestation on Public Land**
  - **- Make Forest for School Yard**
  - **- Field Studies for Youth**
  - **- Preventing desertification in Northeast Asia**
  - **- Providing information of forest through Internet**
  - **- Advertising campaign**
- **Campaign Rating : No. 1**

KEEP KOREA GREEN
SINCE 1984

Campaign Logo

24

Community
Reforestation of Public land


Before Plantation (1985)


16 Years Later (2001)

25

Community
Forest Conservation


Planting Trees by Newly-Wed Couples

Since 1985


'Green Camp' for High School Girls since 1988

26

Community
School Forest


School Yard without Green




Beautiful School Yard

27

Community
Reforestation in China


Poplars Planted


Reforestation & Resurrection of Life

28

Community
Social Responsibility

- **Sustainability Reporting**
  - One of the Early Adaptors since 2001
  - Consumers, Customers, Trade Associations, Research Institutes, Academia, Government, NGO, Employees, …

29

Community
Social Responsibility

- **Korea Business Council for Sustainable Development**
- **Sponsoring of 'Literature House, Seoul'**
- **Enhancement of Senior Welfare**

30

Conclusion

Sustainable Material + Sustainable Process

⇩

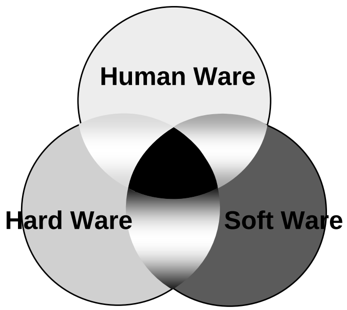
Sustainable Products

⇩

Sustainable Company

⇩

Sustainable Society / Country



31

Thank you !

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82-2-528-1073

32

Profile

Name Ahn JoongWoo, Ph.D.
Affiliation Sr. Director of Sustainable Management, Yuhan-Kimberly

Education:

B.S. in Chemical Technology, Seoul National University
Ph. D. in Polymer Science/Plastics Engineering, University of Massachusetts, Lowell

Professional Career:

1987 -1990	University of Lowell Research Foundation, USA [Post-Doctoral Fellow]
1990 - 1991	Spire Corporation, USA [Senior Scientist]
1991 - 1992	Doosan Technical Center, Korea [Team Leader of Adhesive Team]
1993 -2001	Procter &Gamble Korea, Inc.[Section Head of Professional & Regulatory Service]
2001 - Present	Yuhan-Kimberly [Sr. Director of Sustainable Management]

Research Fields/ Interests:

- Life Cycle Assessment
- Eco-Labelling
- Eco-Design
- Solid Waste Man

Committee/ Boards:

- Environmental Committee Member of Korea Chamber of Commerce
- Korea Delegate to ISO/TC207/SC5,6 in the ISO 14000 Scheme
- Judge Board Member of Korea Type III Eco-Labelling
- Technical Advisory Board Member of Metropolitan Landfill Corporation
- Editorial Board Member of “Eco-Vision 21”
- Editorial Writer of “The Global Environment News Weekly”
- Director General of Korea Society of Life Cycle Assessment
- Finance Director of Korea Environmental Toxicology Society
- Director General of Korea Composting Council

Selected Publications:

- Eco-Design (DongHwaTech, 2005)
- Treatment of Industrial Wastes (ShinKwangMunhwaSa, 2000)
- In-Vessel Composting of Sewage Sludge (DongHwaTech, 1998)
- Waste Minimization Principle (JiSikProcessing, 1997)
- Principle of Life Cycle Assessment (Korea Industry Federation, 1995)

Toward Sustainable Circulation of Products among Asian Countries

Yasushi Umeda Ph.D.
Professor, Department of Mechanical Engineering, Graduate School of Engineering
Research Institute for Sustainability Science (RISS), Osaka University

Abstract

A lot of wastes are exported from Japan to Asian countries, including China, Philippine, and Vietnam. Let me call it global circulation among countries. While some of them are appropriately reutilized, most of them cause various problems, such as dumping of contaminated wastes and pollution of air and water because of inappropriate recycling processes. Such exported artifacts can be classified into three levels; namely, (1) reuse circulation where products and components are sold in secondhand markets such as cars, construction machinery, and PCs, (2) recycling circulation where materials are recycled, and (3) waste exportation where wastes are exported just for dumping. While waste exportation is obviously against the Basel Convention, other two circulations are not always illegal. In reality, the global circulation, which more or less contains gray area in its legality, is very active because of its profitability, although its environmental effects are not considered. The reason why the global circulation is so active comes from the economic disparity between developed and developing countries.

However, if the global circulation is managed appropriately including full care of the environmental effects, it can bring about some advantages that cannot be achieved by the local circulation of disposed artifacts in Japan. Such advantages may include: extension of lifetimes of products and components (e.g., secondhand market of products and spare parts reuse) that may increase living standards in developing countries and, at the same time, resource efficiency of product life cycles, higher recycling rate in manually operated recycling processes because of lower labor costs than in automated recycling processes in Japan, and a good means for ensuring resources with recycled materials in developing countries.

Moreover, since many factories of, for instance, white goods and PCs sold in Japan, are located in Asian countries, one may say that it is quite natural to send disposed products back to its birth place for establishing the closed-loop circulation system. In order to such environmentally conscious global circulation, or sustainable global circulation, it is indispensable to ensuring traceability by visualizing the flow of circulation and appropriately managing them.

For clarifying prerequisites of such sustainable global circulation, we are constructing models of the global circulation of assembled products based on the idea of life cycle simulation. Life cycle simulation is our simulation methodology that dynamically simulates circulation of a product life cycle including reuse and recycling loops and evaluates a product life cycle from both of economical and environmental viewpoints. Our preliminary study, which takes a personal computer as an example, suggests that while the global circulation for only recycling materials of disposed PCs is not so profitable nor so environmentally conscious because of potential risks in the destination countries (e.g., sudden changes of environmental regulations, theft, and lower quality management), product reuse in the secondhand market increases profitability and reduces environmental load. Here, we assume that the circulation does not include illegal paths. The main problem of this research is lack of practical data (e.g., even ship freightage fee from Japan to Asia) and invisible flows of product and component reuse and recycling. Therefore, accumulation of practical data is quite important for discussing the global circulation. Now, we are developing several models of the global circulation of products: for example, a model that imports disposed product among Asian countries to Japan and recycles them with very high technologies.

Toward Sustainable Circulation of Products among Asian Countries

Yasushi Umeda

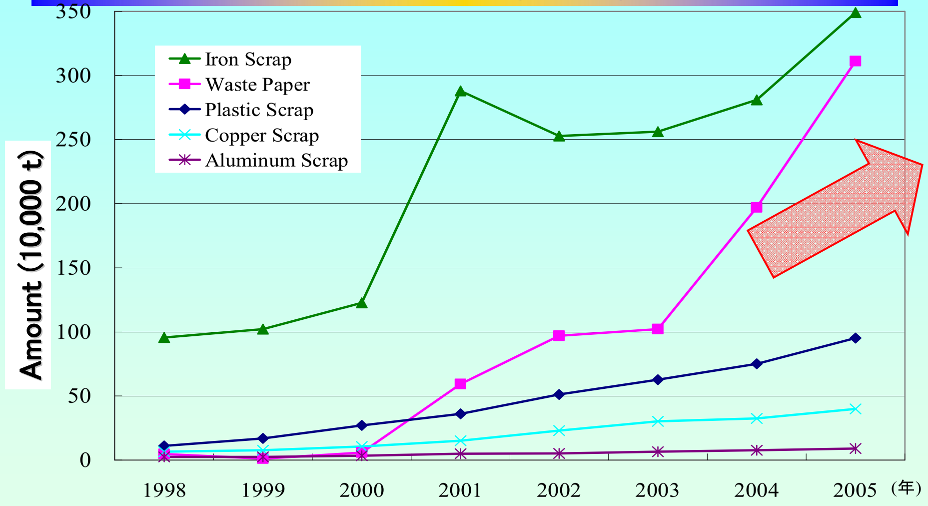
Professor, RISS, Osaka University

Introduction

- A lot of wastes are exported from Japan to Asia = Global circulation among countries
  - E.g., large amount of electric home appliances and PCs goes out of the domestic recycling flow
- Objectives of this presentation
  - Discuss issues and possibilities of the global circulation
  - Discuss prerequisites of sustainable global circulation
  - Describe a simulation of a global circulation of a personal computer

2

Statistics of Export of Scraps from Japan to Chain & Hong Kong



[財務省 貿易統計をもとに作成]

3

Current Status of Global Circulation – Typical Examples

- Reuse circulation: products and components are sold in secondhand markets
  e.g., cars, construction machinery, and PCs
- Recycling circulation: materials are recycled
  ⇨ largest amount
- Waste exportation: wastes are exported just for dumping.
  ⇨ Obviously, against the Basel Convention

- **But, not all circulations are illegal, while most include undetectable *gray paths***

4

Secondhand Car Parts Market in Bangkok

5

Current Status of Global Circulation – Driving Forces

- Economic disparity
- Weaker environmental legislation in destination countries
- Shortage of natural resources in rapidly developing countries

- Artifacts are circulating purely because of economical reasons, without considering environmental consciousness

6

Current Status of Global Circulation – Problems

- In destination countries
  - Dumping of contaminated wastes
  - Air and water pollution because of inappropriate recycling processes
    e.g., Burning printed circuit boards in a field
- In exporting countries
  - Criticism of pushing wastes onto poor countries
  - Higher risks in uncontrolled waste management
  - Decline in recycling industries
    e.g., PET bottle recycling in Japan

7

Material Recycling of Motors in a Field

8

Current Status of Global Circulation – Potential Advantages

- Extension of lifetimes of products and components
  - Increase living standards in developing countries
  - Increase resource efficiency of artifacts
- Cheaper costs (labor cost, land cost, …)
  - Cheaper labor costs enables higher recycling rates in manually operated recycling processes
- Ensuring resources in developing countries
- Many factories of, e.g., white goods and PCs, are located in Asian countries

⇨ It is natural to send disposed products back to its birth place for establishing the closed-loop circulation system.

9

Manual Sorting of Plastics

10

Examples of Well-Managed Global Circulation

- Closed-loop plastics recycling in Cannon
  - Paper trays in photocopiers (HIPS) are collected and shredded in Japan
  - Material recycled into engineering plastics (higher value!) in Thailand
  - Plastics are used for manufacturing printers in Thailand
  - Printers are exported to Japan
- Global recycling network of photocopiers in Fuji Xerox

11

Global recycling network of photocopiers in Fuji Xerox [T. Watanabe 2005]

12

Global recycling network of photocopiers in Fuji Xerox [T. Watanabe 2005]

- Characteristics
  - Higher recycling rate than traditional local recycling plant (almost equal to that in Japan)
  - Strong emphasis on “Tracking system”

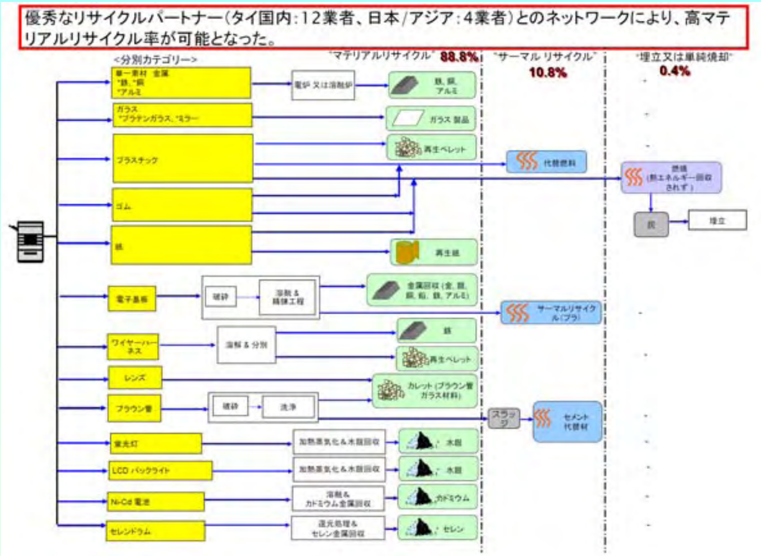
13

Fuji Xerox’s Observations

- Principles for their global circulation
  - Do not export wastes
  - Never illegal dumping
  - No environmental impacts on the destination country
  - Return profits to the destination country
- Future issues
  - Unified international regulations on material transfer
    - » Applicability of the Basel Convention differs country by country
  - Organization authorizing companies’ global circulations

15

Global recycling network of photocopiers in Fuji Xerox [T. Watanabe 2005]



14

Prerequisites for Sustainable Global Circulation

- Full care of the environmental effects
- Traceability
  - Visualizing the flow of circulation
  - Appropriate management of the flow
- Equity among related countries

- In the current Asian status, it seems the only possibility is the global circulation system owned and managed by a reliable global company

16

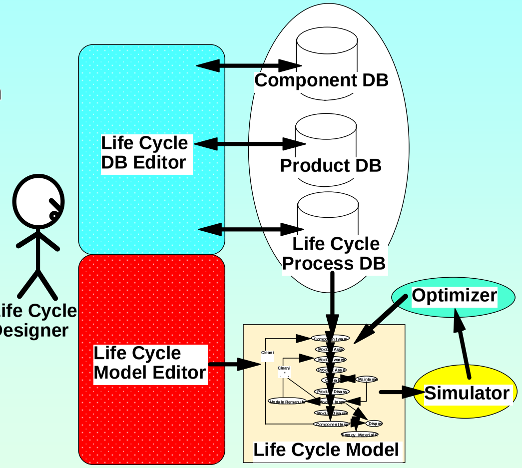
Preliminary Study on Modeling and Evaluation of the Global Circulation

- Tries to develop models of the global circulation
- Evaluates various scenarios by using these models, from economical and environmental viewpoints
- Hopes to clarify conditions for sustainable global circulation and to propose some successful patterns

17

Life Cycle Simulation

- Simulate flow of artifacts throughout a product life cycle based on discrete event simulation technique
- Evaluate balance of a PLC from economical and environmental viewpoints
- Advantages
  - In addition to LCA, it simulates
    - » Dynamics of circulation such as reuse, failure of components, and recycling
    - » Economical aspect



18

Case Study: Circulation of Desktop Personal Computer

- Simulation conditions
  - Target product: Desktop PC
  - Target regions: Japan and coast and inland in China
  - Start point: PCs are thrown away in Japan
  - No secondhand value in Japan, but are sold in secondhand market in China
  - No illegal paths are considered

Objective and Obstacles of the Simulation

- Find the Conditions for Successful Resource Circulation
  - Economical Merit: Benefit should be greater than 'Zero'
  - Environmental Merit: CO2 Emission should be less than 'domestic recycling in Japan'
- Obstacles for the simulation
  - Real flows are unclear
  - Not enough practical data
  - ⇨ Introducing Risks and Data Width

Beijing, China(2005)

Modeling Uncertainty

- Uncertainty in material flow: introduce Risks
  - Unexpected events
    - » Theft, to the illegal channel, failure in customs clearance, …
    - » Fire in factories, environmental pollution, …
  - Risk = Probability × Impact
  - Counter measures (CM): Risk' = Risk × (1 – effect) where, 0 < effect <1
    - » Conditions: ΔRisk > costs for CM
- Uncertainty in data: represent as data width

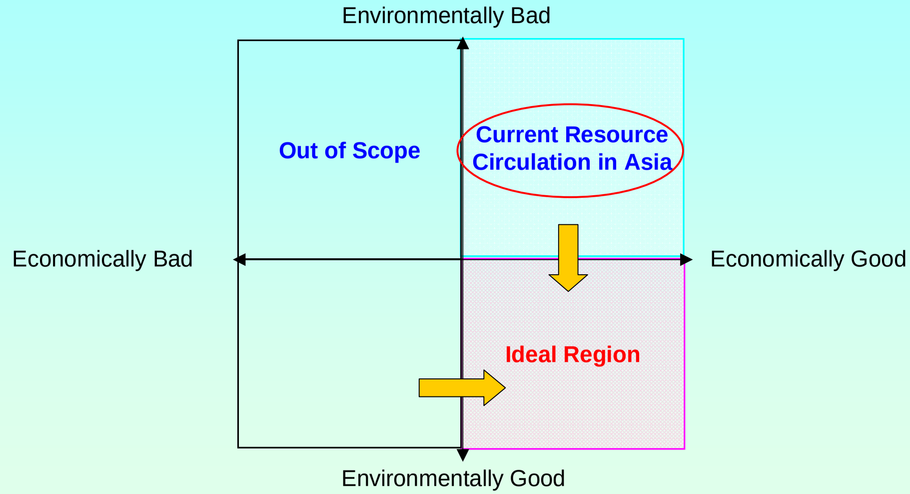
21

Scenarios

A. Domestic recycling (Japan)	Material recycling other than plastics
B. Product reuse (coast area in China)	Products are sold as secondhands
C. Part reuse and material recycling (coast area in China)	Reusable parts: HDD, FDD, CD-ROM, and PCB Others, incl. plastics, are recycled
D. Material recycling (coast area in China)	All materials are recycled
E. Material recycling (inland area in China)	All materials are recycled
F. Material recycling (Japan + coast area in China)	Shredded and metals are recycled in Japan, and then plastics are exported and recycled in the coast area

22

Evaluation Axes



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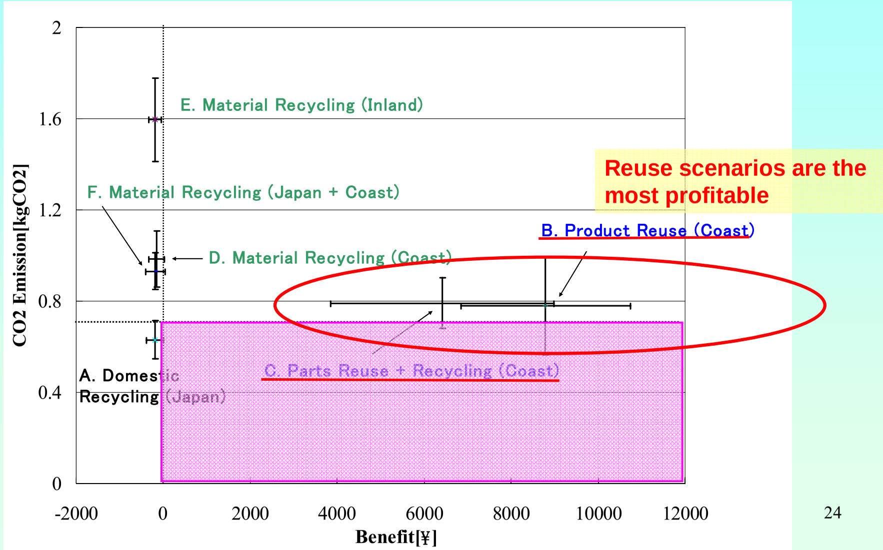
Summery of the Simulation Results (Including Risks)



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Risk Data

- Case Examples of Risks & Counter Measures
  - Asahi Newspaper
  - Searchina [http://news.searchina.ne.jp/]
  - JST Failure Knowledge Database
- Data (Risk Probability, Impact)
  - Business Risk: Illegal Sales, Strike, etc

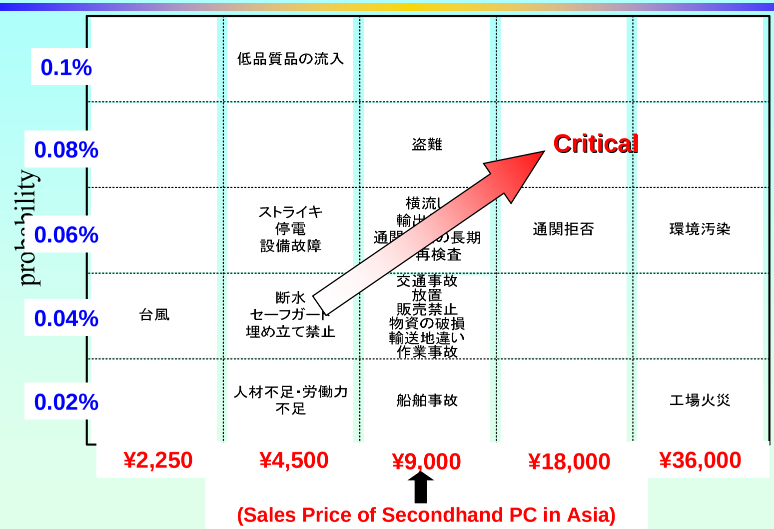
    ⇒ Estimate Roughly 'Impact' and 'Probability'

    e.g., Impact of 'PC Theft': Nearly Equal to Sales Price of the PC
  - Environmental Risk: Compensation for Damages (e.g., Recovery of Soil Pollution, etc)

    ⇒ Ask Prof. Sakagami (Osaka Univ.)

25

Considered Risk



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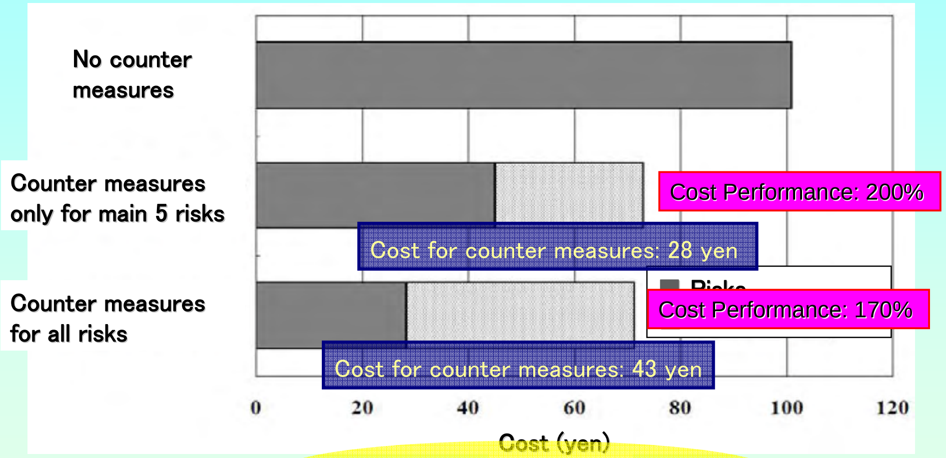
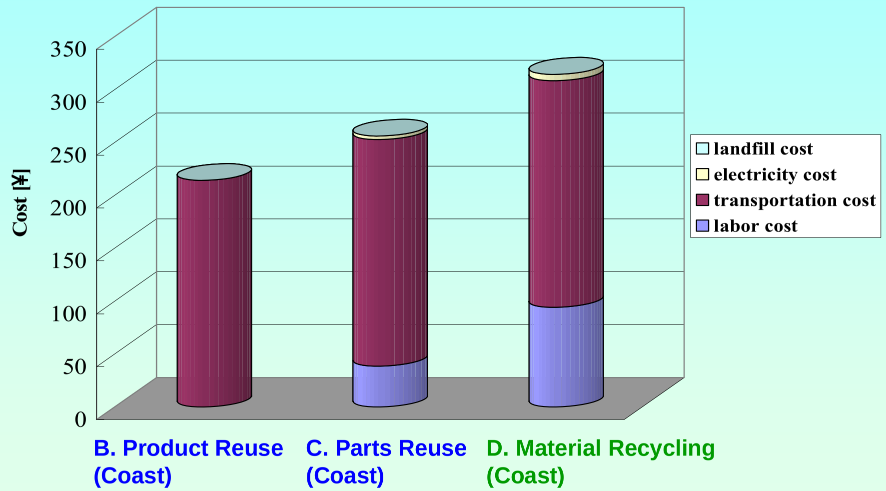
Effects of Counter Measures against Risks



Necessity for Risk Management

27

Breakdown of Costs in each Scenario



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Messages learned from the Preliminary Study

- Reuse scenarios are the most profitable
  - Critical factor is “yield rate”
- Recycling scenarios is not profitable and increases CO_2 emission
  - But, there seems to be recycling circulations of PCs
  - The assumption that all processes are well managed increases costs
  - Higher risks than the domestic recycling
- Better circulation requires
  - Risk management
  - Well combination with the domestic recycling

29

Problem for Modeling and Simulating the Global Circulation

- Lack of practical data
- Invisible flows

⇨ Accumulation of practical data is indispensable for discussing the global circulation

- Effects of ensuring traceability system and life cycle management are not yet considered.

30

Conclusions

- Discussed issues and possibilities of the global circulation
- Discussed prerequisites of sustainable global circulation
  - Traceability
  - Accumulation of practical data

⇨ A practical form is global circulation system owned and managed by a reliable global company

- Describe a simulation of a global circulation of a personal computer
  - Reuse circulation is plausible, while recycling circulation needs improvement

31

Profile

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Affiliation Professor, Department of Mechanical Engineering, Graduate School of Engineering
Research Institute for Sustainability Science (RISS), Osaka University

Education:

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1999-2005	Associate professor in Tokyo Metropolitan University
2006-Present	Member in Research Institute of Sustainable Science (RISS)
2006-Present	Member in Research Institute of Sustainable Science (RISS)

Research Fields/ Interests:

- Environmentally conscious design
- Lifecycle Engineering
- Lifecycle simulation
- Design theory and methodology
- Maintenance engineering, and knowledge intensive engineering

Selected Publications:

- Y. Umeda, A. Nonomura, and T. Tomiyama: Study on life-cycle design for the post mass production paradigm, AIEDAM, Cambridge University Press, Vol. 14, No. 2,pp. 149-161, 200
- J. Fujimoto, Y. Umeda, T. Tamura, T. Tomiyama, and F. Kimura: Development of Service-Oriented Products Based on the Inverse Manufacturing Concept, Environmental Science & Technology, Vol. 37, No. 23, pp. 5398-5406, 2003.
- Y. Umeda, S. Kondoh, Y. Shimomura, T. Tomiyama: Development of design methodology for upgradable products based on function-behavior-state modeling, AIEDAM, Vol. 19, No. 3, pp. 161-182, 2005.
- Y. Umeda, S. Kondoh, T. Sugino: Analysis of Reusability using 'Marginal Reuse Rate', Annals of CIRP 2006, Vol. 57/1, CIRP, 2006.

Human, Society, Global Environment
Research Institute for Sustainability Science
大阪大学
サステイナビリティ・サイエンス研究機構
Osaka University Research Institute for Sustainability Science

Concept of closed-loop society for Asia and Flagship Project of IR3S

Nov 22, 2006, *Icho Kaikan*, Osaka University

Research Institute for Sustainability Science (RISS)
Prof. Tohru Morioka*[1] and Flagship project member*[2]
*[1]Director, Design House of RISS, Osaka Univ.
***[2] O.Saito, Y. Yamamoto, Y.Yamaguchi, H.Yabar, K.Hara, H.Zhang,and M.Uwasu**

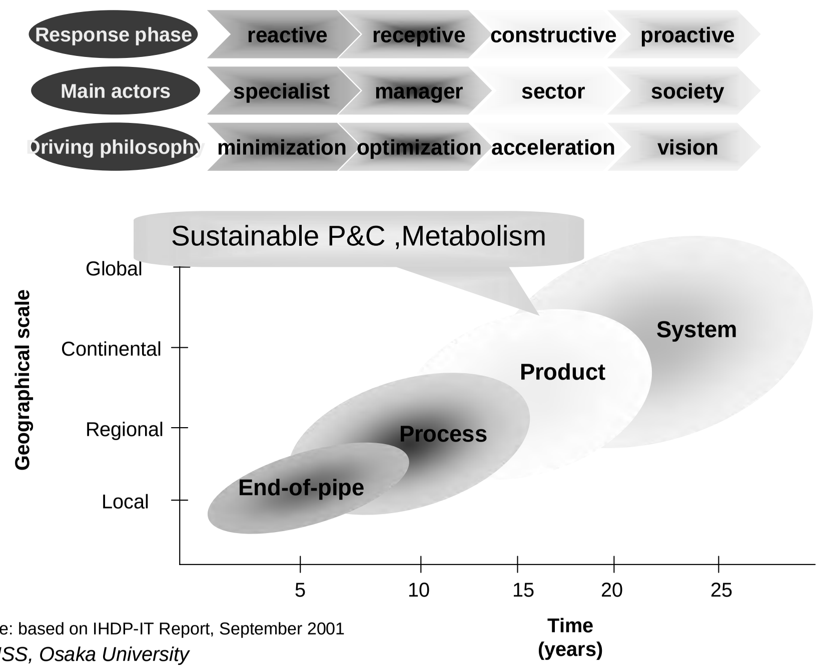
 1

Concept of closed-loop society for Asia and Flagship Project of IR3S

Industrial transformation is defined as <u>integrated actions of the environmentally sound development of industrial systems</u> of production process, corporation, industrial estate, city/region, and the global economy with eco-efficiency innovation and green product/service supply chain management to achieve life-cycle-based minimization of environmental burdens towards Sustainable Asia.

 2

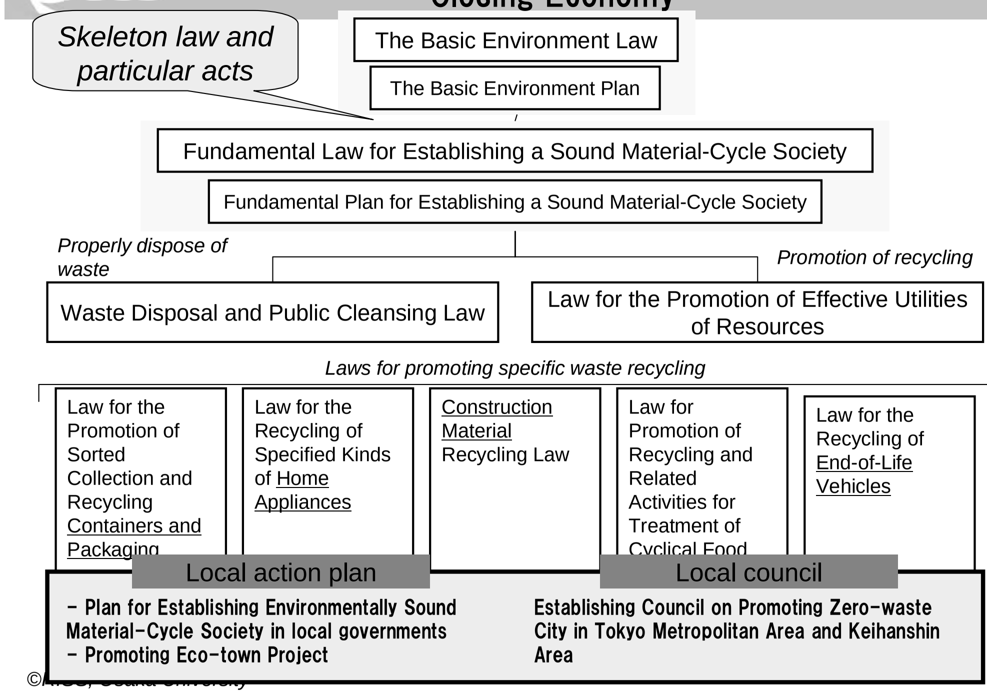
1. Socio-economic Evolution towards Sustainable Development



Source: based on IHDP-IT Report, September 2001

 3

2. Framework of the Implementation Plan towards a Loop-Closing Economy



 4

3. Fundamental Plan and Specific Laws for Establishing a Closed-loop Economy

Regional (Asia)

Asian Standard of Loop- closing Initiatives based on 3R concept

-Promotion of the 3Rs
-Reduction of barriers to the international flow of goods and materials
-Cooperation between developed and developing countries
-Encouragement of cooperation among various stakeholders
-Promotion science and technology suitable for the 3Rs

Japan's Action Plan for Developing Global Zero Waste Society

National

Fundamental Law for Establishing a Sound Material-Cycle Society

Laws for promoting specific waste recycling

- Law for Promotion of Sorted Collection and Recycling of Containers and Packaging
- Law for Recycling of Specified Kinds of Home Appliances
- Construction Materials Recycling Act
- Food Recycling Law
- Domestic Automobile Recycling Law

Law Concerning the Promotion of Procurement of Eco-Friendly Goods and Services by the State and Other Entities

Fundamental Plan for Establishing a Sound Material-Cycle Society

Local

Local action plan	Local council
Plan for Establishing Environmentally Sound Material-Cycle Society in local governments – Promoting Eco-town Project	Establishing Council on Promoting Zero-waste City in Tokyo Metropolitan Area and Keihanshin Area

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4. Japan's Action Plan for Developing Global Zero Waste Society Through 3R Initiative

-Promotion of the 3Rs (higher priority to material input reduction and product reuse)
-Reduction of barriers to the international flow of goods and materials
-Cooperation between developed and developing countries
-Encouragement of cooperation among various stakeholders
-Promotion science and technology suitable for the 3Rs

Asian FTA-EPA

Japan's Action Plan for Global Promotion of Zero Waste International 3R Initiatives

Realization of zero-waste society in Japan and dissemination of the experience

✓Implementation of the fundamental Plan to establish a sound material-cycle society, integral and quantitative targets
✓Further strengthening of 3R actions: DfE, local plans, individual recycling laws, etc

Support for the zero-waste societies in developing nations

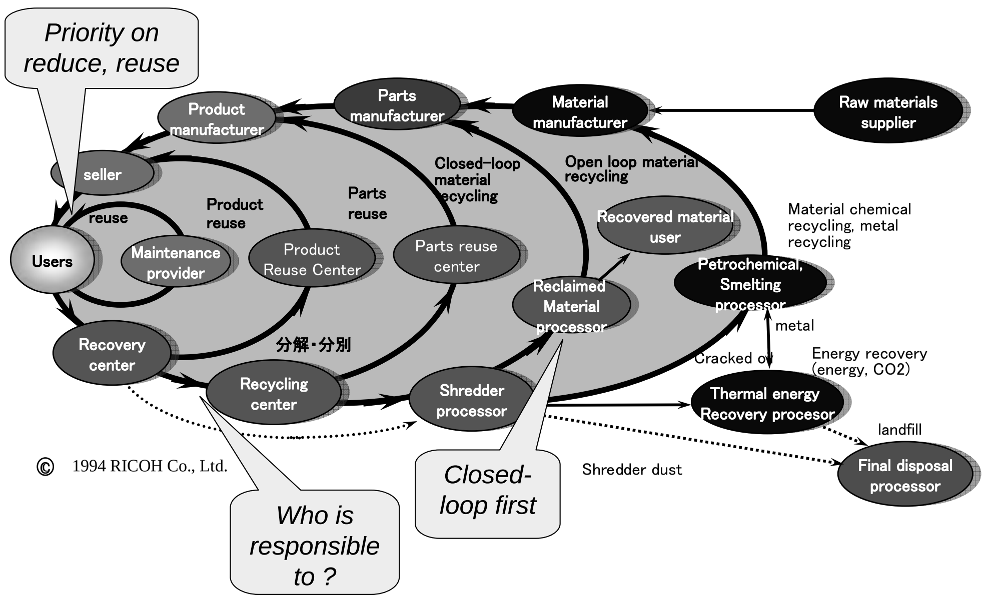
✓ Capacity building for establishing sound material-cycle society in developing countries. Ex. Eco-product fair organization , hubs creation via capacity building, support for recycling, etc

International cooperation to realize world-wide zero-waste societies

✓Implementation policy measures towards developing zero-waste policies in cooperation with various countries and institutions. Ex. Official meetings for 3R initiatives, strengthening linkages with international organizations, formulation of East-Asia sustainable society vision, etc
✓Enhancement of knowledge base and technology base for promotion of zero-waste in Asia
✓Zero-waste society promotion through providing information and developing networks

©RISS, Osaka University Source: Japan Ministry of Environment Homepage: http://www.env.go.jp/recycle/3r/en/approach/01.pdf 6

5. Sustainable Product Chain Management



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6. Corporate Green Management Strategy

Input, output, process, policy

Stakeholder Evaluations

Management

Strengthening of environmental governance
Performance of company efforts
Employee incentive systems & performance evaluation system
Strengthening of risk communication

Data release
Risk Communication

Green procurement for materials, parts

Purchasing & Procurement Div.	Development & Design Div.	Manufacturing Division	Sales Division
Development and expansion of green procurement routes	Design and development of eco-products using LCA, DfE	Efforts towards zero emissions, energy saving systems in manufacturing	Strengthened sales of green products and services

Provision of green products & services

Implementation of environmental management systems, environmental auditing and env. Management accounting
Coordinated implementation of energy saving systems, 3R efforts and strategies against hazardous chemicals

Exchange with stakeholders

Planning, Management and PR Div.

Improved provision of information concerning corporate env. efforts (business activities, products, services)
Promotion of Disclosure tools (environmental reports)
Improved environmental advertising

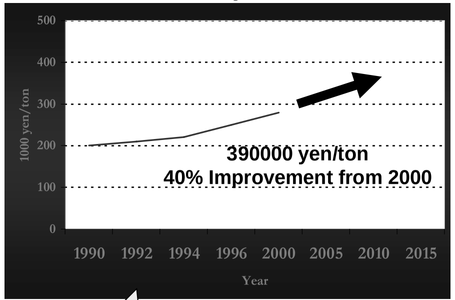
Data release

Legend
Products/ services
Information

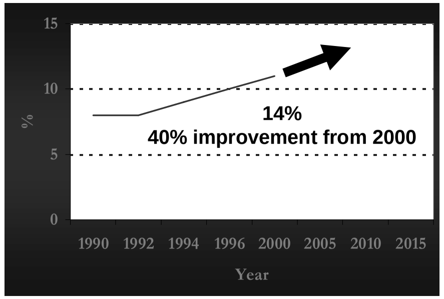
©RISS, Osaka University Source: METI, Development of eco-oriented nation: http://www.meti.go.jp/english/information/downloadfiles/cEnv0310-02e.pdf 8

7. MFA based Indicators in Japanese Environmental Policy

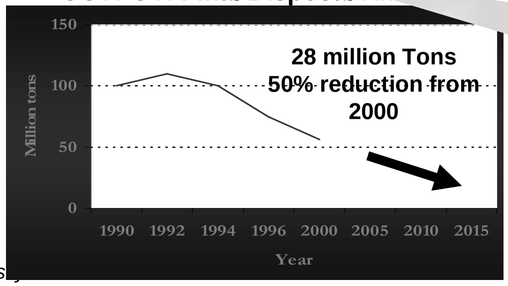
INPUT: Resource Productivity = GDP (Service) / DMI



CYCLING: Recycling Rate



OUTPUT: Final Disposal Amount



Macroscopic Input-output indicators are improved under the guide of government and corporate efforts

From Economic Efficiency to Environmental Efficiency

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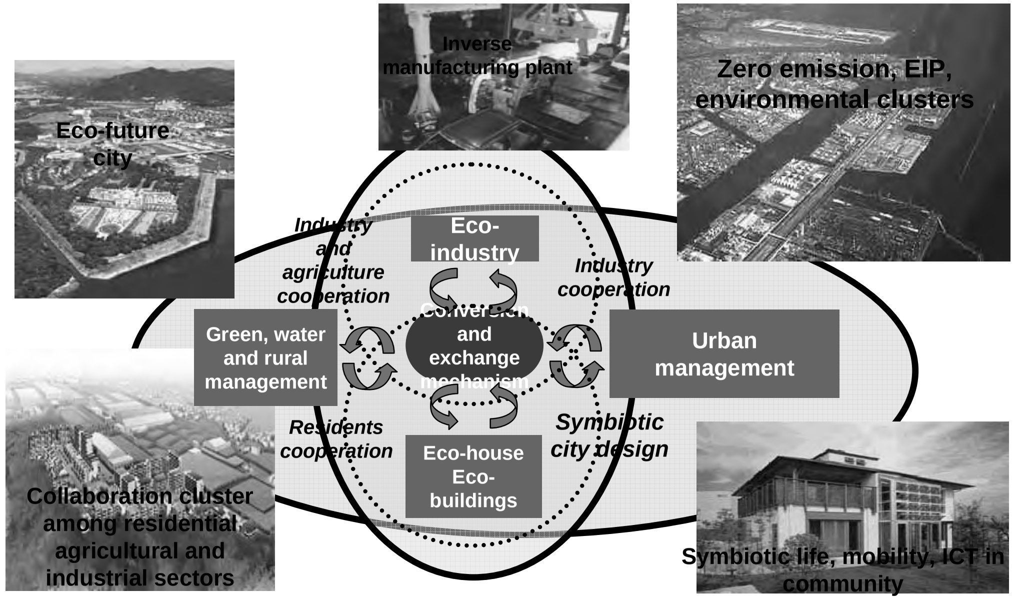
8. Industrial Closed-Loop Implementation at Regional Scale



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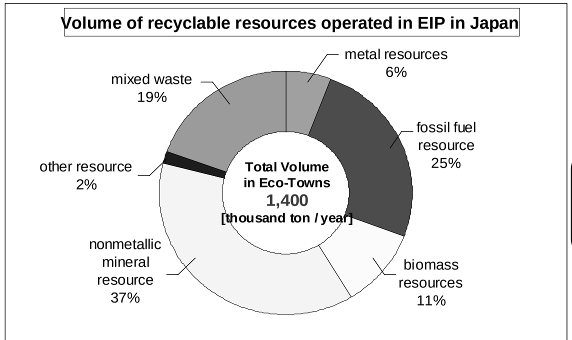
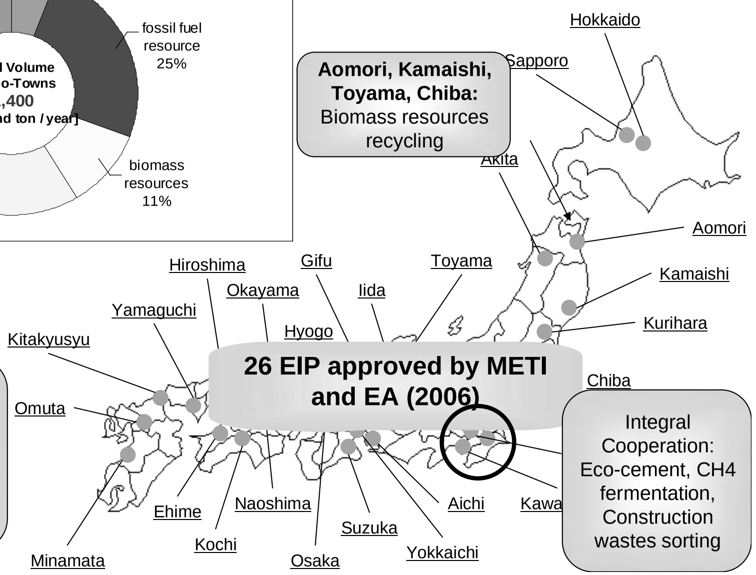
9. Eco-Town Projects in Japan





Kitakyushu: Comprehensive EOL resources (PET, home appliances, OA equipment, wood, fluorescent tubes, construction wastes, etc

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10. EIP Initiatives in Asia

networking

Country	Location
China	Dalian, Yantai, Soo Chow, Tianjin, Guiging, Yixing, Taihu, Shanghai, Chong Yuan, Guiyang and Jiangsu, Shi Hezi, Guigang, Nanhai, Quzhou, Zaozhuang, Lubei
Philippines	Laguna International Industrial Park, Light Industry and Science Park, Carmelray Industrial Park, LIMA, Laguna Techno park, Philippine National Oil Company Petrochem Industrial Park, Clean City Center project (USAID). GTZ project with PEZA & EPIC.
Indonesia	Lingkungan (LIK), Tangerang; Semarang; Industry Sona Maris
Malaysia	LHT resources linkage.
Korea	Master EIP Plan launched in 2003. Six proposals: Banwol Siwha, Mipo Onsan, Yeosu, Chungju, Jinhae Haman Jinju, and Pohang
Taiwan	Tainan Technology and Industrial Park, Changhua Coastal Industrial Park; CSS II (corporate synergy system II) projects, Hua Lian and Kaohsiung (2003) Taoyuan and Tainan Ta Shin 3/23/2004 (40,22,31,30 hectares)
Vietnam	Amata (environment management), Hanoi Sai Dong II (feasibility study).
Thailand	Industrial Estate Authority of Thailand plans (Map Ta Phut, northern region, Amata Nakorn, eastern sea-board, Bang Poo); Samut Prakarn province CPIE project; Bangkok (Panapanaan).
Singapore	Jurong Island Industrial Park

Source: IE Asia Conference (2001), EIE Asia Conference (2004), Bruce Chung, www.eco-industrial.net

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11. Sustainable Development :Socio-economic shared responsibility

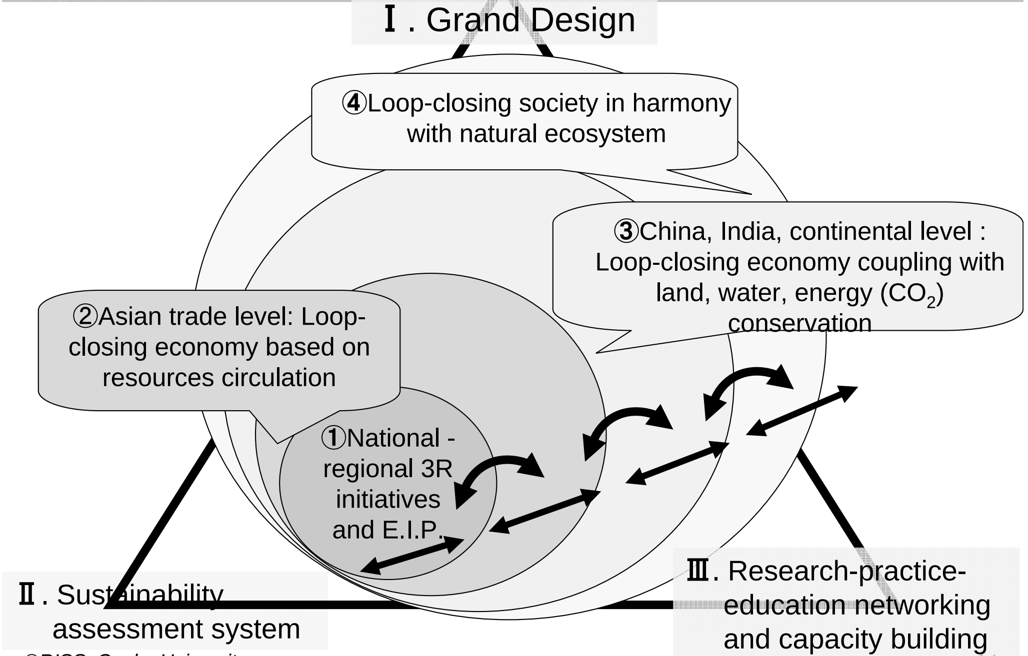
Three principles of pollution responsibility

- **Polluter Pays Principle**
  "A principle under which users and producers of pollutants and wastes should bear the responsibility for their actions. Companies or people that pollute should pay the costs they impose on society"
- **Extended Producer Responsibility**
  "*An environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of the product's life cycle* " **(OECD)**
- **Shared Responsibility for Indirect or Shadow Effects**
  "All partners in the production and consumption chain have a role to play in their particular part of this chain" **This approach is not established in spite of RoHS, EuP, or REACH in EU.**

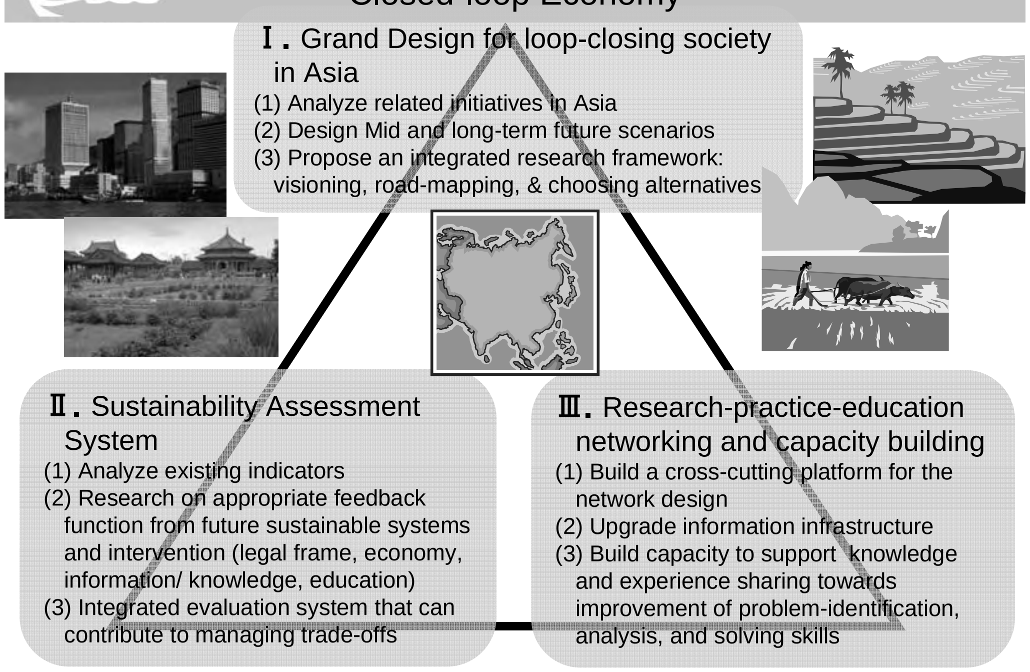
In the Asian region, trade of goods as well as bads (= wastes) is of crucial components. However,

- **Division of international production**: Given that industrial products are manufactured in the manner of the division of labor at national or international level, these three principles are not sufficiently applied under the current regulation systems in Asia. (What if some parts of a product contain toxic substances that were produced in different countries? Who takes the responsibility?)
- **Inappropriate trade of wastes, recyclables, recycled**
  On the one hand, lack of monitoring capacity and the gray zone of regulations causes pollution a heaven issue; on the other hand, strict restrictions hinder necessary trade of wastes.
- **Capacity building and establishing of new systems**

12. International Cooperation IR3S Flagship project: Loop-closing society in Asia



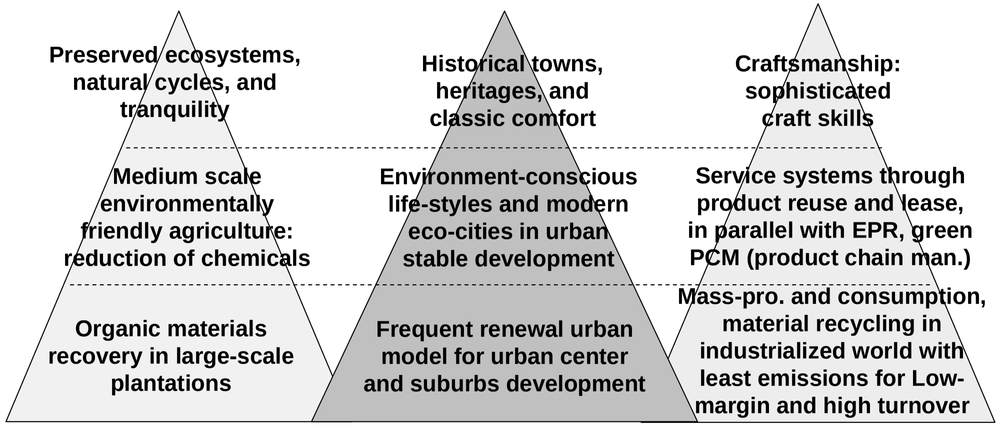
13. Research Plan for the Design of Asian Closed-loop Economy



14. International Cooperation (Flagship Project: Loop-closing Society in Asia)

- Conceptualize the "Asian" loop-closing society (Economy).
  - Propose a future sustainable society: Visioning
  - Eco-industries development is the key to the establishment of sustainable metropolitan region which rapidly grow in Asia
- Dynamic scenarios are significant because:
  - the future desirable society will probably change over time.
  - Asian countries are closely related in their economies as well as the environmental issues.
- Integrated approaches to examine vision, alternative scenarios and road maps:
  - Need to establish the cooperative network not only for researchers from different disciplines but also researchers from different countries (including Vietnam, Japan, China, among others).
- Specification of R&D Mission
  - Local respect: 2030 society･･･ the path followed by industrialized and non-industrialized countries/region as well as coastal and inland areas will probably be different
  - Space, time scales, key variables in the specification!
  - The specification will help show how to go from scenarios to roadmap.

15. Urban-Rural-Industrial Triangle Model (simplified concept)



【Biological Production Ecosystem】

Water and Land Management for Land and Production Systems.

【Urban System】

Human settlement, mobility, construction and their environmental consequences are concerned.

【Industrial system】

Material processing and recycling by using fuel, intensive energy etc on land with infrastructures.

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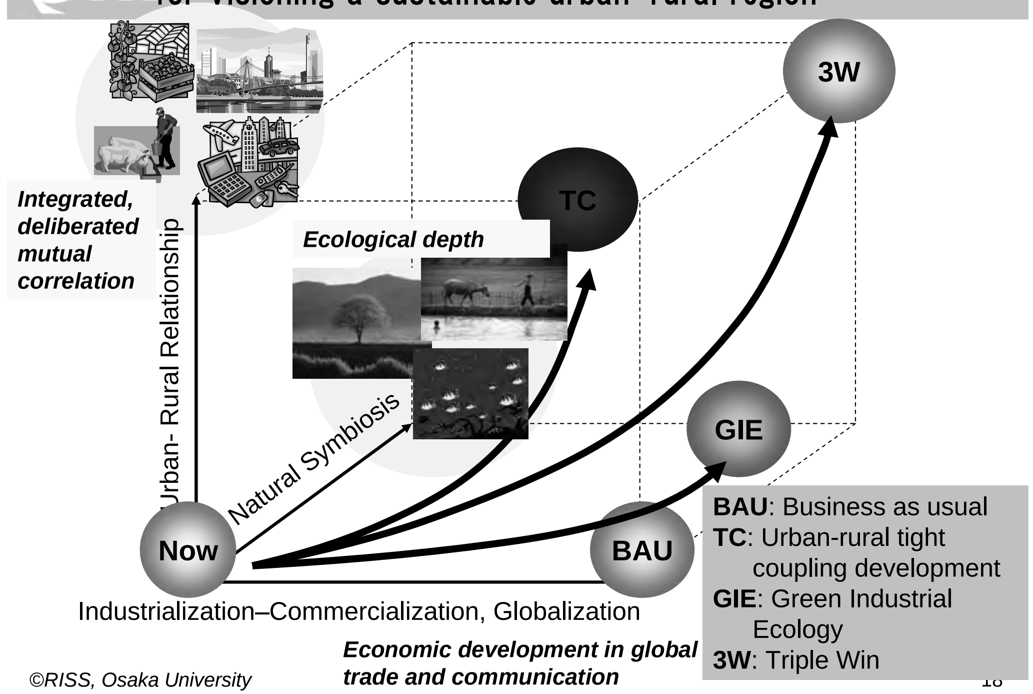
16. The scheme and key factors of scenario-driven approach for visioning a sustainable urban–rural region



BAU: Business as usual
TC: Urban-rural tight coupling development
GIE: Green Industrial Ecology
3W: Triple Win

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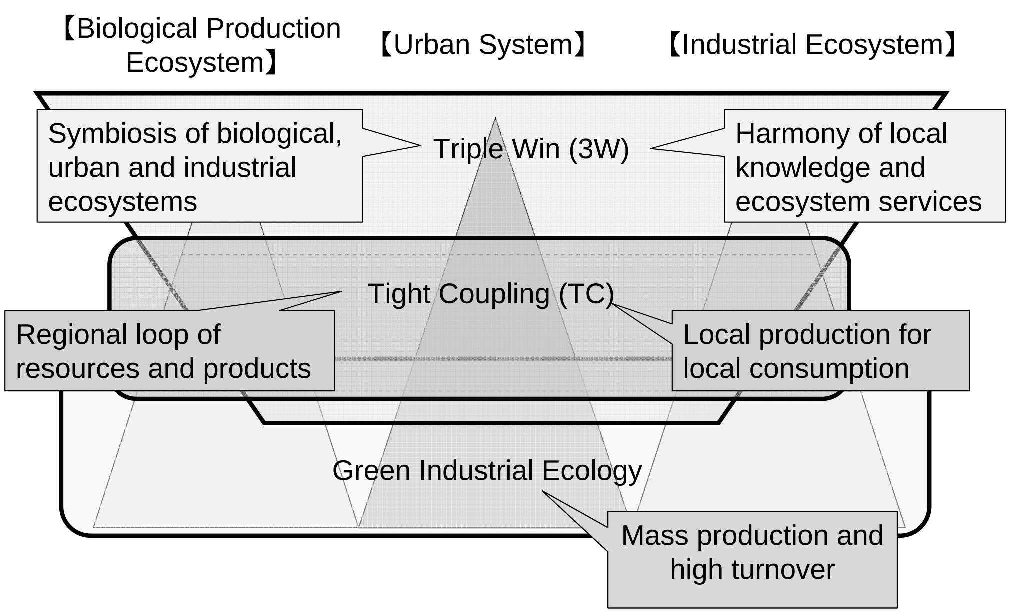
17. Three Alternative Scenarios



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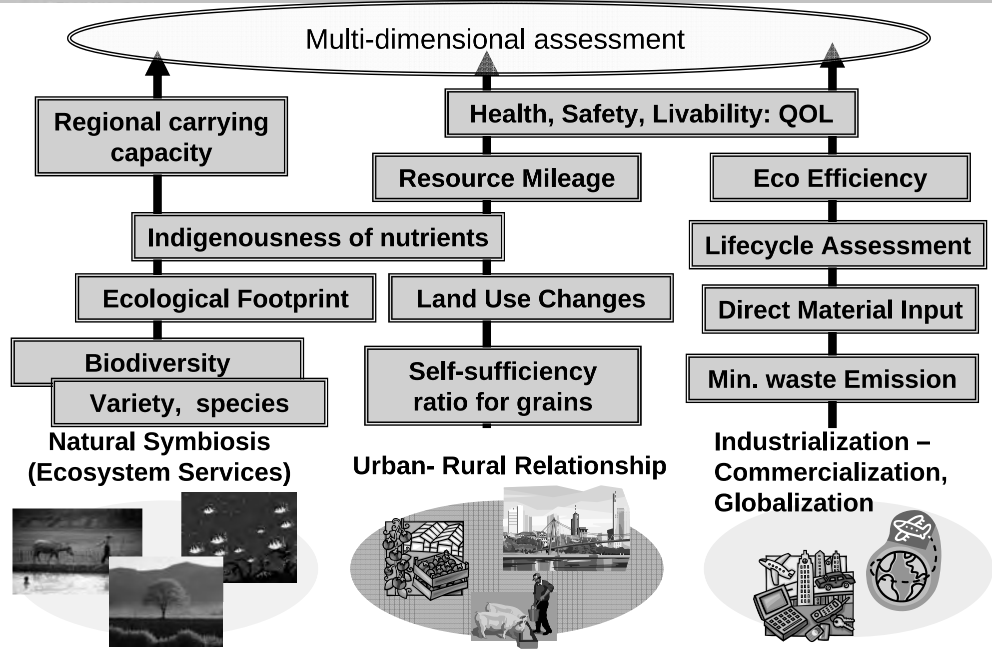
18. Development of Sustainability Indicator System



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19. Flagship Project - Research Proposal

① **Establishment of Asian Closed-Loop Economy**

- Differences from European Initiative: **Asian life style in Asian town/villa**
- Coupling economic development with sustainability: **Decoupling with burdens**
- Symbiosis with nature: **Water front and greenery for blue-green corridor**
- Dealing with trans-issues: population increase, poverty, climate change, biodiversity, water scarcity, etc :**Comparing eco-cities initiatives in China, etc.**
- Management of ELP or e-wastes distribution and specific attributions in closed loop (**Irregular or inappropriate reuse or trade, Spread of ITC technologies**)

② **Research scheme**

Implementation of international research collaborative project initiatives with Vietnam and China, with Korea and others

- Specification of **targeted case study areas; Ho Chi Minh, Hanoi in Vietnam**
- Necessity of **counterparts** in the case study areas
- Collection of data and analysis of case study areas (Social design, green industry promotion, environmental initiatives, current technology, current policy implementations)
- Fund for **continuing research**

Contact Information

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Closing Message

Tohru Morioka, Ph.D.
Professor, Director of Research Institute for Sustainability Science, Osaka University

Profile

Name Tohru Morioka, Ph.D.

Affiliation Professor, Graduate School of Engineering, Osaka University
Director of Research Institute for Sustainability Science, Osaka University

Education:

1969 B. of Engineering, Dept. of Sanitary and Environmental Engineering, Kyoto University

1971 Master of Engineering, Dept. of Sanitary and Environmental Engineering, Kyoto University

1974 Doctor of Engineering, Dept of Sanitary and Environmental Engineering, Kyoto University

Professional Career:

1974 Research Assistant, Dept. of Environmental Engineering, Osaka University

1976 Associate Professor, Dept. of Environmental Engineering, Osaka University

1993 Professor, Dept. of Environmental Engineering, Osaka University

1998 Professor, Dept. of Environmental Engineering, Graduate School of Eng., Osaka University.

Research Fields/ Interests:

- Designing loop-closing system with high eco-efficiency for biomass and organic waste, metal resources, nonmetal materials, and chemicals measured by MFA, environmental accounting, and impact modeling.
- River basin management and city region planning for ecologically sound and environmentally sustainable region supported by means of GIS, scenario-writing tool and environmental impact assessment technique.
- Systems approach to environmental management of business corporations under the societal pressures of green procurement/purchasing programs, environmental reporting and hazardous chemical reduction program
- Environmental risk assessment and management under various uncertainty in the special program (2004-2009) entitled as “Environmental Risk Management Training Program” supported by Japan Min. of Education and JST.
- Designing green energy supply and consumption in human dimension programs for global environmental change

Selected Publications:

- Tohru Morioka, Noboru Yoshida et. Al., Cycle-closing product chain management with appropriate production site metabolism toward zero-emission in an industrial machinery corporation, *Clean Technology and Environmental Policy*, 6, pp.7-17, Springer, 2003
- Kiyotaka Tsunemi and Tohru Morioka, Evaluation of advanced loop-closing system of steel recycling, *Journal of Global Environment Engineering*, vol. 10, pp. 27-38, Japan Society for Civil Engineers, 2004.
- El-Lithy Khaled, Tsuyoshi Fujita and Tohru Morioka, GIS-based assessment of CO_2 emission caused by automobile trips for shopping: case study in Muko River basin region, *Journal of Global Environment Engineering*, vol. 10, pp. 113-128, Japan Society for Civil Engineers, 2004
- Takamasa Yano and Tohru Morioka, The integrated management system of ISO standards, *Journal of Global Environment Engineering*, vol. 10, pp215-224, Japan Society for Civil Engineers, 2004
- Tohru Morioka, Kiyotake Tsunemi, Yugo Yamamoto, Helmut Yabar, and Noboru Yoshida, Eco-efficiency of Advanced Loop-closing Systems for Vehicles and Household Appliances in Hyogo Eco-town, *Journal of Industrial Ecology*, Vol.9, No.4, pp.205-221, 2005
- Tohru Morioka, Osamu Saito and Helmut Yabar, The pathway to a sustainable industrial society – initiative of the Research Institute for Sustainability Science (RISS) at Osaka University, *Sustainability Science*, Vol. 1, pp. 65-82, 2006