

PROPOSING A FRAMEWORK TO DESIGN FUTURE SCENARIOS FOR A RESOURCE-CIRCULATING SOCIETY IN ASIA

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This study aims to propose a framework in which future scenarios are formed toward a desirable resource-circulating society. Firstly, existing future scenario studies are reviewed and summarized as a basic foundation of this study and subsequently a framework to form future scenarios for possible resource-circulating societies is proposed taking an example of the Yangtze Delta in China. Three systems, namely, "Urban system", "Industrial system" and "Biological ecosystem," are taken into account as a dimension for envisioning the scenarios. The proposed framework shall provide a basis for further development of the research on future scenarios in the field of resource-circulation strategies.

Key Words : *Back-casting approach, Future Scenarios, Resource-circulation, Sustainability*

1. INTRODUCTION

One of the biggest challenges that the modern society faces is how to decouple economic development from environmental pressure within the limits of the earth's carrying capacity. If we consider the socio-economic gap between and within countries as well, the challenge becomes even more difficult.

Asian countries have been enjoying a continuous and rapid economic growth in the last decades with industrialization and urbanization. However the rapid economic growth has been, in most cases, accompanied by over-consumption of resources, environmental degradation and urban-rural socio-economic gaps, to mention just a few. Shen et al (2005)¹⁾, for instance, analyzed the relationships between urbanization and the supply and demand of major energy and mineral resources for China in the

future, and concluded that China will inevitably face a great shortage of resources if future urbanization is faster than predicted. Without envisioning sound resource-circulating societies and directing the society properly, Asia, not to mention the world, will fall into an unsustainable path.

Visioning a sustainable resource-circulating society in the context of the backcasting approach is an innovative method to direct the society to a desirable path in the future. The following points are particularly imperative in developing the research in the field of the resource-circulating strategies.

- 1) Grand design for a resource-circulating society: envisioning a desirable and sustainable society of the future based on defined parameters, such as, driving forces, trends, sectoral development, and policies, followed by the design of mid-term and long-term scenarios with their inclusive technology roadmaps;
- 2) Assessment system: developing relevant

indicators that allow to rightly evaluate and judge the progresses towards a resource-circulating society, based upon the envisioned scenarios;

There exist future scenario studies in such areas as climate change. Yet, very few studies have been carried out and reported in the field of promoting a "resource-circulating society". Given the current situation, this study aims to propose a framework towards developing future scenarios in order to advance a sound and sustainable society with the strategies of resource-circulation, particularly in the context of Asia where resource consumption and associated environmental impacts are and will be rigorous due to the increasing economic activities. Despite the predicted difficulty in drawing the scenarios in a completely objective manner, the study shall provide a basic knowledge base for the further development of the research on future scenarios related to resource conservation and circulating strategies.

Firstly, the scenario studies that exist worldwide are overviewed and summarized as a basis of making a framework for the scenario in the study, followed by an attempt to propose a framework for making future scenarios. The framework is based on the design of future scenarios which takes into account the main driving forces (demographic, economic, industrial structure, science and technology, environment, etc), the development trends of the main sectors (agriculture, industry, transport, energy) and the intervention policies (macro and sectoral policies). The Yangtze delta area was selected as a representative example of Asian case study, as the area is densely populated and economically quite viable, presumably leading to high resource consumption and environmental loads.

2. REVIEW OF SCENARIO STUDIES

The concept of sustainable development has been derived from the concern about the ability of the earth natural carrying capacity to support the increasing impacts of human activities²⁾. Even though there have been important improvements in this direction mainly through individual and incremental efforts, the road towards sustainability requires the understanding of the links between its three main dimensions; namely, environment, society and economy. A vision of a future desirable society is essential to boost the current efforts and

strategies towards sustainable development. Scenario design plays a central role in this task not only because it tells us the possible consequences if we continue our current production and consumption patterns but it could also provide alternative viable options to achieve a sustainable society.

(1) Global scenario studies

Most of the global scenario studies towards sustainability proposed so far basically follow a similar pattern: analysis of the current state of the system based on past trends, identification of the driving forces which could condition the path of the future of the system and assumptions with regard to the main sectors of the system under study. Raskin et al³⁾ described the structure of six major global scenarios based upon time horizon, the regions covered and the focus of the study. Morioka et al²⁾ summarized various international scenario studies in terms of five global challenges: climate change, depletion of energy resources, degradation of ecosystem services, over-consumption of non-renewable resources and decoupling of industrialization from environmental pressure. In this analysis each challenge was described in terms of four criteria: carrying capacity concept, indicators and targets, major driving forces and policies, and commitment.

(2) Scenarios for sustainable resource management

While the rapid economic growth of Asian countries has been most of the times accompanied by enormous resource consumption and environmental degradation, decoupling strategies could lead us to the path towards sustainable resource management. The benefits of increasing resource productivity would be very significant because it will be possible to keep economic growth at considerable lower levels of resource consumption and environmental impacts including emissions to air, water and land. Most of the research literature so far has focused on the analysis of past developments and current trends of material consumption and resource productivity based on the Material Flow Analysis (MFA) approach^{4, 5, 6)}. Some studies have also proposed policy frameworks for sustainable resource management. Bringezu (2006)⁷⁾, for instance, proposed a generic policy approach that focuses on increased resource efficiency and reduced use of all primary resources.

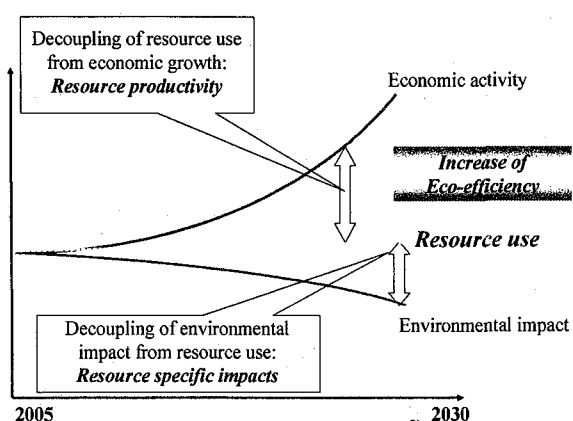


Fig. 1 Resource strategy in EU⁸⁾

At the regional level the European Union (EU) has made a lot of efforts in sustainable resource management. Under the 6th Environment Action Program (EAP,) the EU developed a thematic strategy on sustainable use of resources. As shown in Fig. 1, this strategy proposes a double decoupling: economic growth from resource use (resource efficiency increase) and resource use from environmental impacts⁸⁾.

The EU project called MOSUS (Modeling Opportunities and limits for restructuring Europe towards sustainability) actually designed an economic-energy-resource model that simulates development scenarios for Europe until 2020 and evaluates the impacts of the policy measures on both the economic and environmental indicators⁹⁾. The project develops three scenarios: the baseline scenario in which projections of further trends observed in the last 25 years are made and no particular policy strategies are encouraged, the weak sustainability scenario which reflects policy goals and measures from key documents of the EU and the strong sustainability scenario which includes more ambitious policy goals, based on the scientific

literature¹⁰⁾.

3. FRAMEWORK TO MAKE FUTURE SCENARIOS - CASE IN YANGTZE DELTA

(1) Background of the Yangtze Delta

This study looks into the Yangtze Delta area for the future scenario making as one case study. The area comprises 16 cities of the triangular-shaped territory of Shanghai city, southern Jiangsu province and northern Zhejiang province of China. Particularly, Yangtze Delta Metropolitan Area is a highly populated area with over 82 million residents as of 2004. This area is economically viable. For example, the proportion of gross production outputs of the secondary and tertiary industry in the area, compared with the whole country, accounts for 22 % and 30% respectively in 2004 (Table 1). Indeed, Yangtze River Delta economic area is one of the fastest growing regions in China and tremendous land-use change has occurred¹¹⁾. This situation offers a rationale of taking the area as a reasonable case to seriously consider the resource conservation strategies and attempt to design the future scenarios for promoting a resource-circulating society.

(2) Condition for making scenarios

Conditions and boundaries need to be set for framing the future scenarios. The followings are such conditions that are applied in the scenario making of this study.

a) Dimension - Three systems for Scenario design

In this study, three systems, including "urban system," "industrial systems," and "biological ecosystem," are recognized as the dimension upon which the future scenarios for resource-circulating society are formed. The future scenario is framed through visioning possible or desirable directions of

Table 1 Socio-Economic Background of the Yangtze Delta Economic Zone (as of 2004).

	Land area (10,000 km ²)	Population (10,000 persons)	Gross Product Output of industries (100 million Yuan)				Cultivated areas (1,000 ha)	Floor space of building (10,000 m ²)
			Total	Primary Industry	Secondary industry	Tertiary industry		
Yangtze Delta Area*	11.0	8212.0	28775.0	1324.7	16073.4	11377.4	3396.2	36208.8
% to National Total	1.1	6.3	21.1	6.4	22.2	30.0	2.6	17.5

Source: China Statistical Year book for Regional Economy, 2005¹²⁾

* Yangtze Delta Economic Zone

each individual system and their interactions within the study area. The biological ecosystem focuses on water and land management for land and production systems. The urban system addresses human settlement, mobility, construction and the consequent environmental degradation. And the industrial system stresses the importance of material processing and recycling.

b) Concept of “Resource-circulating society”

In advance of making the scenarios, the concept of “resource-circulating society” needs to be defined. Japan’s concept of recycling-oriented society has basically emphasized: 1) saving the natural resources use and 2) reducing environmental impacts associated with resource consumption. In China, on the other hand, the 11th five-year plan, which was stipulated for the year from 2006 through 2010, stresses the promotion of so-called “Circular Economy.” The concept of Circular Economy, in comparison with Japanese policy, is rather unique in that it emphasizes on the preservation of the environmental systems including ecosystems, water and land¹³⁾.

A series of meetings, attended by the experts involved in this study, were set up to discuss the appropriate criteria and indicators for evaluating the resource-circulating society and define the concept of a resource-circulating society of the study. As a result, the following three were chosen as main criteria with which to evaluate the resource-circulating society.

- 1) Saving resources use
- 2) Reducing environmental impacts associated with resource consumption
- 3) Preservation of eco-systems

The selection of the criteria is, again, based upon the three systems defined as the dimension for framing the scenarios; urban system, industry system and biological system. The third criterion above is directly linked to the “biological ecosystem.”

(3) Framework to design scenarios

Fig. 2 describes a conceptual framework for future scenario and back-casting approach in the field of resource-circulating strategy. First, a set of future scenarios, with a time horizon of 2030 and 2050, are to be envisioned based upon various conditions set. The backcasting approach will be applied and roadmaps to reach the envisioned scenarios shall be identified. The backcasting approach can be applied to this type of long term complex issues¹⁴⁾. It should be noted that hereby the basic criteria to evaluate the resource-circulating society include: 1) saving resource use, 2) reducing environmental impacts and 3) preserving eco-system, all of which are referred to

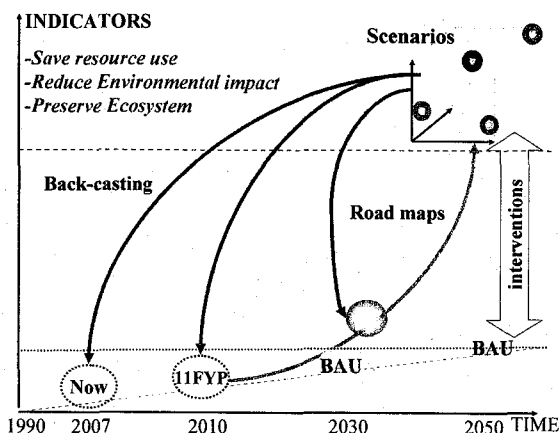


Fig.2 Scheme of future scenarios and back-casting approach.

*11 FYP indicates the 11th Five-Year Plan in China.

** BAU stands for “Business As Usual.”

*** The study takes three systems - urban system, industry system and biological system - as a set dimension and the systems are expressed as respective axes in the “scenarios”

as indicators in X axis of Fig. 2. It is also important to mention that China stipulated in its 11th Five-Year Plan through the year 2010 the aim to direct the society from not only the socio-economic viewpoint, but also environmental aspects, with specific indicators set. Therefore, the scenarios should be made on the basis of the targets set by the 11th Five Year Plan at the macro level.

Fig. 3 shows a process of forming the future scenarios. Driving forces in terms of society, industry, economy and environmental aspects should be examined quantitatively and qualitatively. In the case of China, sectoral development is already supported by policies and thus, this has to be taken

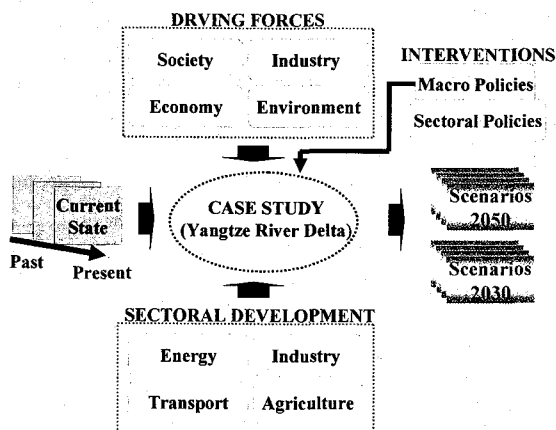


Fig.3 Process to frame future scenarios

Table 2 Components to be reflected in scenario making.

Target area	Yangtze Delta area
Dimension set-up	<ul style="list-style-type: none"> - Economic development, region intra and extra gaps, environmental conservation, resource circulation - Linkages between urban system, biological ecosystem, industrial system
Sectoral development	Energy, Industry, Agriculture, Transport
Driving forces	<ul style="list-style-type: none"> - <u>Society</u>: population, urbanization - <u>Economy</u>: GDP, trade, etc - <u>Environment</u>: resource use, land use change, pollution, etc - <u>Industries</u>: primary, secondary, tertiary (production outputs)
Interventions	<ul style="list-style-type: none"> - Macro policies (economic, regulatory, voluntary, etc) - Sectoral policies (Energy, Industry, Agriculture and Transport)

into considerations when designing the scenarios. At the same time both macro and sectoral policies are important in the sense that they provide the intervention means to achieve the desired socio-economic and environmental changes.

Table 2 summarizes the main components that require consideration in making the scenarios in the case of Yangtze Delta. As a highly populated, industrial and environmentally polluted region, Yangtze delta has all the ingredients of a rapid development area. The main driving forces that will possibly shape the future of the Yangtze Delta are the population and urbanization in the social aspect, economic growth and industrial structure in the economic aspect and the quality of the environment and resource use in the environmental aspect. At the same time it is important to pay special attention to the possible development of the main sectors of the region namely: energy, industry, agriculture and transport. Finally, the intervention policies for both

the driving forces and the sectoral development must also be considered.

4. ENVISIONED SCENARIOS

Following the process and framework proposed in this study, and based on the expert meetings, four possible scenarios were drawn in a descriptive manner, assuming the case of Yangtze Delta. It should be noted that there were some factors which are subjective to qualitative analysis. **Table 3** summarizes the outline of the four envisioned scenarios. Scenario 1 outlines the modern industrialized system with economic efficiency. This system is characterized by export-oriented production, organic materials recovery in large-scale plantations; frequent renewal of urban center and suburbs development; mass production and consumption, material recycling in industrialized world with low emissions. Scenario 2 outlines an acceptable level of industrial transformation. This system is characterized by an appropriate-scale and organic agriculture and promotion of urban-rural interrelationship; environment-conscious life-styles and modern eco-cities in an urban stable development; and service systems through product reuse and lease, in parallel with extended producer responsibility (EPR) and green product chain management. Scenario 3 addresses the deep ecology view. This system is characterized by preserved ecosystems, natural cycles, and tranquility; preservation of historical towns, heritages, and classic comfort; and craftsmanship: promotion of sophisticated craft skills. Scenario 4 identifies a harmonious balance of the three systems i.e. industrialization that respects the environment with the participation of both urban-rural areas. This scenario needs strong relationship and collaboration between consumers who demand environmentally friendly products and services and producers who

Table 3 Examples of Scenario through the combinations of three systems

	Urban system	Industrial system	Ecological system
Scenario (1)	Frequent renewal of urban centers and suburbs development	Manufacturing industry stress on exports	Organic circulation based on large-scale plantation type agriculture
Scenario (2)	Environment-conscious lifestyle, modern eco-cities, service society	Acceptable level of industrial transformation, EPR	Appropriate level of organic agriculture, sound urban-rural interrelationship
Scenario (3)	Preservation of historical towns and heritage,	Craftsmanship, emphasis on sophisticated craft skills	Preservation of ecosystems and natural cycles
Scenario (4)	Integrated service-based consumption	Green industry, integral eco-efficiency	Urban-rural symbiosis

fulfill the increasing demand.

5. CONCLUSIONS

This study reviewed the scenario studies to accumulate relevant knowledge and build a basis of scenario studies regarding a resource-circulating society, which is the main theme of the study, and then attempted to propose a framework of the future scenarios with the actual case of the Yangtze Delta area in China. Based upon the proposed framework, four scenarios were drawn as a trial, depending on the combinations of the three systems; urban system, industrial system and biological ecosystem. The framework and processes proposed will be able to lay a foundation for the research realm of future scenarios and backcasting approach associated with resource conservation strategies.

For a future study, further detailed analysis of the case study in the Yangtze Delta area shall be carried out, with a refined quantification of such factors as driving forces and sectoral developments. Also, possible roadmaps including the technologies and policy options that would allow to fill the gaps between current status and the envisioned scenarios, as indicated in Fig. 2, should be drawn as well. Equally important is to develop the assessment methods that could be applied to the research on resource-circulating society. Appropriate selection of indicators and assessment using the multi-dimension indicators selected shall help to judge the proposed scenarios in a quantitative and qualitative manner and assess whether society is moving toward the envisioned futures.

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