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# The Concept and Implications of Eco-Efficiency

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# Ⅰ. Original Definition of Eco-Efficiency

■ The 1992 Earth Summit (Rio De Janeiro)
- endorsed eco-efficiency
- as a means for companies to implement Agenda 21
- in the private sector

■ The term was coined
- by World Business Council for Sustainable Development (WBCSD)
- in its 1992 publication "Changing Course".
- describing as the concept of creating more goods and services while using fewer resources and creating less waste and pollution.

# Ⅰ. Original Definition of Eco-Efficiency

■ According to WBCSD, eco-efficiency is achieved

- through the delivery of competitively priced goods and services that satisfy human needs and bring quality of life
- while progressively reducing environmental impacts of goods and resource intensity
- throughout the entire life-cycle to a level at least in line with the Earth's estimated carrying capacity.

# Ⅰ. Original Definition of Eco-Efficiency

■ Strategies for achieving eco-efficiency (WBCSD)
- reduction in the material intensity of goods or services
- reduction in the energy intensity of goods or services
- reduced dispersion of toxic materials
- improved recyclability
- maximum use of renewable resources
- greater durability of products
- increased service intensity of goods and services

■ Basic version on eco-efficiency (WBCSD)
- reduction in ecological impacts translates into an increase in resource productivity
- which in turn can create a competitive advantage

# Ⅰ. Original Definition of Eco-Efficiency

■ The 5th Ministerial Conference on Environment and Development in Asia and Pacific
- organized by United Nations ESCAP (Economic and Social Commission for Asia and Pacific)
- held in Seoul in 2005
- applied its conceptual meaning to the whole national economy as an ideology of green growth

■ The 2002 Earth Summit (Johannesburg)
- declared eco-efficiency as the core practical means to the achievement of sustainable development
- recommended all countries to adopt eco-efficiency

■ Eco-efficiency has become synonymous with a management philosophy geared towards sustainable development.

# II. New Approach to Eco-Efficiency

## 1. Effectiveness and Efficiency

■ The state goal is achieved, mobilizing an institutionalized means

■ The means mobilized are the determinants of how successfully the goal is achieved.

■ Effectiveness

- degree to which the goal is achieved.
- a measure of the match between the goal and its achievement.
- focusing on “how much the goal is achieved”.
- “doing the right thing for achieving goal”.

# Ⅱ. New Approach to Eco-Efficiency

■ Efficiency

- the extent to which the means mobilized achieves its goal without wasted resources, effort, time, or money (using the smallest quantity of resources possible)
- a measure of the match between the goal and the means mobilized in terms of rationality and/or relevance.
- "doing thing the right way for achieving goal".

**2. Eco-Efficiency**

■ a compound concept including both ecological and economic efficiency.

■ a concept implying an attempt to achieve both economic and ecological efficiency.

# II. New Approach to Eco-Efficiency

■ Economic efficiency
- is to achieve economic development efficiently
- in a way of maximizing economic development
- through minimum use of natural resources
- with minimum emission of polluted materials in the process of production, distribution, and consumption.

■ Ecological efficiency
- is the efficiency with which energy is transferred from one trophic level to the next.
- is determined by a combination of efficiencies relating to organismic resource acquisition and assimilation in an ecosystem.

# II. New Approach to Eco-Efficiency

■ Eco-efficiency as a compound concept of both economic and ecological efficiency in a framework

- is a vision for the production of economically valuable goods and services while reducing the ecological impacts of production.
- a means producing more with less impact on ecosystem.
- two are in conflict in terms of their goal.
- eco-efficiency: weak sustainability
- eco-effectiveness: strong sustainability

# II. New Approach to Eco-Efficiency

■ Measuring eco-efficiency

- eco-efficiency=(environmental cost/economic output)
- environmental cost can be, for example, (indicator)
  - . pollution emission (eg. CO2, SOx)
  - . resource-used (eg. energy or water used)
  - . cost associated with an environmental burden (eg. traffic congestion cost)
- economic output can be, for example, (indicator)
  - . value-added of benefit (eg. GDP per capita)
  - . unit of product or service (eg. per km, per m2)
  - . cost associated with an environmental burden (eg. traffic congestion cost)

# Ⅱ. New Approach to Eco-Efficiency

■ Two important issues related to eco-efficiency
- methodology as a practical means to achieve eco-efficiency.
- indicators for measuring the state and effectiveness of eco-efficiency

# Ⅲ. Methodology for Achieving Eco-Efficiency

■ Definition of methodology
- a body of practical means, procedures, and rules
- being used for achieving the stated goal.
- so, methodology should be both effective and efficient

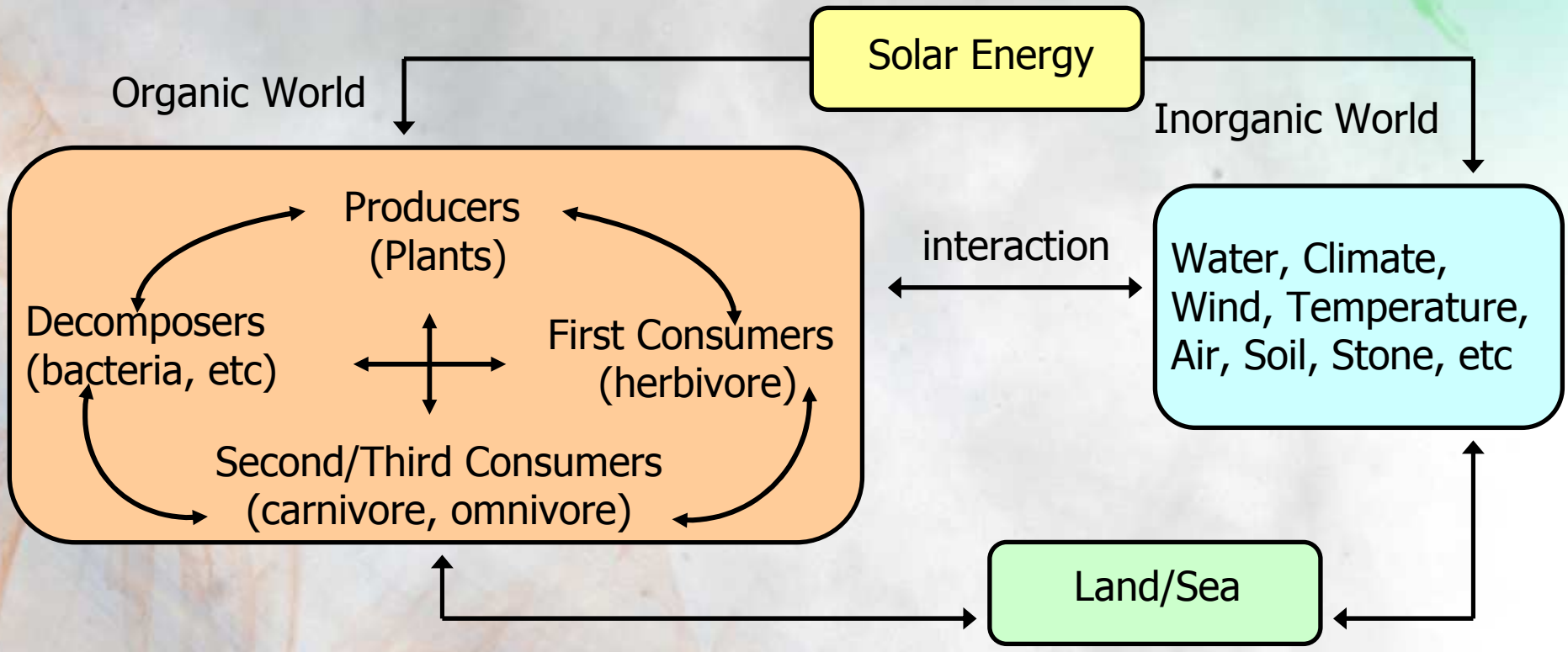
■ The principal focus on developing methodology of eco- efficiency
- more economic production
- with less impact on nature as an ecosystem

■ Thus, methodology
- should be developed in way to be maximum effective and efficient
- on the basis of mutual relationship between economic activity and nature as an ecosystem

# Ⅲ. Methodology for Achieving Eco-Efficiency

■ Nature as an ecosystem

<Figure 1> The Structure of Nature as an Ecosystem

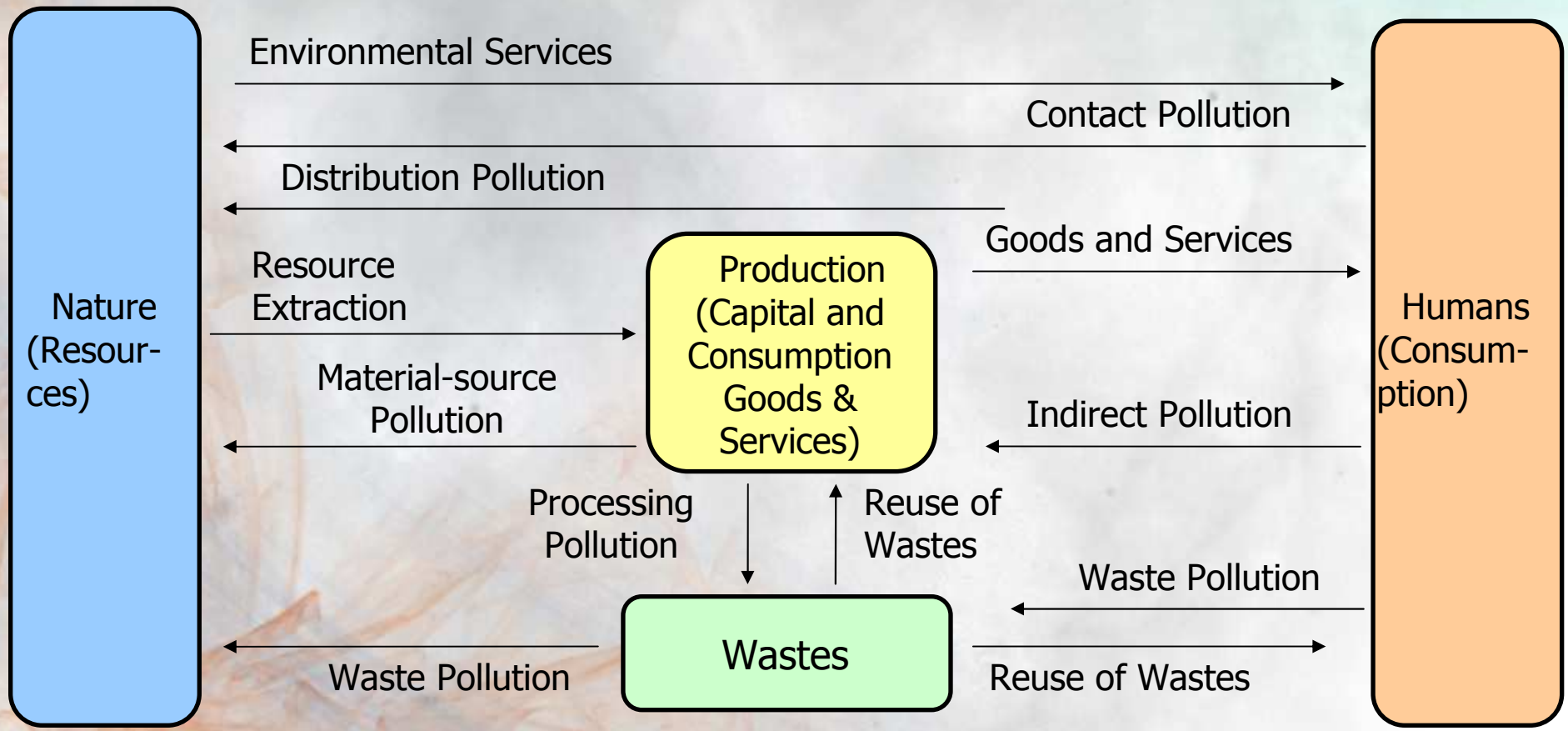



※ Ecological process (mutual dependence: competition, symbiosis, food-chain, etc) → resulted in self-regulating system

# Ⅲ. Methodology for Achieving Eco-Efficiency

■ The mechanism of mutual relationship between economic activity and nature

<Figure 2> The mechanism of Mutual Relationship between Economic Activity and Nature



# Ⅲ. Methodology for Achieving Eco-Efficiency

■ <Figure 1> enables us to identify what categories should be covered in the development of methodology for achieving eco-efficiency (<Table 1>)

<Table 1> Categories of Eco-Efficiency (Example)

| Category | Category |
|---|---|
| Production System | Lifestyle in Everyday Life |
| Technology | Waste |
| Pattern of Energy Use | Conservation of Ecosystem |
| Transportation | Socio-economic Institutions |

■ Methodology depends on how successfully eco-efficiency is achieved.

# Ⅳ. Eco-Efficiency Indicator

■ A reality

- is composed of many sub-elements
(eg. human organism, ecosystem, economic activity)
- each sub-element is used as an indicator connotating the reality as a whole.

■ Definition of indicator

- a variable for observing a reality
- a measure summarizing a reality
- a proxy measure of a reality
- a value providing/describing the information on a reality

# Ⅳ. Eco-Efficiency Indicator

■ Roles of indicator

- synthesizing information on the reality in terms of current state and change
- then, can be used as basic data in the process of decision-making for the management of the reality
- can be used as a critical evaluation scale on the direction and result of policy launched for eco-efficiency by indicator and their whole set.

# Ⅳ. Eco-Efficiency Indicator

## ■ Major indicators of eco-efficiency

<Table 2> Major Indicators of Eco-Efficiency (Example from <Figure 1>)

| Category | Indicator | Category | Indicator |
|---|---|---|---|
| Production System | o Land-use<br>o Resource Productivity | Lifestyle in Everyday Life | o Saving Energy<br>o Saving Resource |
| Technology | o Clean Technology<br>o R&D for Development of Technology | Waste | o Reduction<br>o Reuse<br>o Recycling |
| Pattern of Energy Use | o Pollution Emission<br>o Energy Intensity<br>o Energy Efficiency<br>o Energy Elasticity | Conservation of Ecosystem | o Individual Component of Ecosystem<br>o Flow of Energy and Material |
| Transportation | o Fuel Intensity | Socio-economic Institutions | o Regulation by Directiveness<br>o Regulation by Incentives<br>o Tax Reform |

# Major indicators of eco-efficiency (Table 3 cited from United Nations)

## <Table 3> Framework and Set of Eco-Efficiency Indicator Using Monetary output as Numerator

| Category | Resource-use Intensity | Environmental Impact Intensity |
|---|---|---|
| Economic-wide Indicators | | |
| | o Water Intensity [$m^3$/GDP]<br>o Energy Intensity [J/GDP]<br>o Land-use Intensity [$km^2$/GDP]<br>o Material Intensity [DMI/GDP] | o Emission to Water Intensity [t/GDP]<br>o Emission to Air Intensity [t/GDP]<br>o GHG Emissions Intensity [t/GDP] |
| Sectoral Indicators | | |
| Agriculture | o Water Intensity [$m^3$/GDP]<br>o Energy Intensity [J/GDP]<br>o Land-use Intensity [$km^2$/GDP] | o $CO_2$ Intensity [t/GDP]<br>o $CH_4$ Intensity [t/GDP] |
| Industry | o Energy Intensity [J/GDP]<br>o Water Intensity [$m^3$/GDP]<br>o Material Intensity [DMI/GDP] | o $CO_2$ Intensity [t/GDP]<br>o Solid Waste Intensity [t/GDP] |
| Manufacturing | o Energy Intensity [J/GDP]<br>o Water Intensity [$m^3$/GDP]<br>o Material Intensity [DMI/GDP] | o $CO_2$ Intensity [t/GDP]<br>o BOD Intensity [t/GDP]<br>o Solid Waste Intensity [t/GDP] |
| Public and Services Sector | o Energy Intensity [J/GDP]<br>o Water Intensity [$m^3$/GDP]<br>o Land-use Intensity [$km^2$/GDP] | o $CO_2$ Intensity [t/GDP]<br>o Wastewater Intensity [$m^3$/GDP]<br>o Municipal Solid Waste Intensity [t/GDP] |
| Transport Sector | o Fuel Intensity [J/GDP] | o $CO_2$ Intensity [t/GDP] |

Source: United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). 2009. *Eco-Efficiency Indicators: Measuring Resource-Use Efficiency and the Impact of Economic Activities on the Environment.* pp. 9-10.
Note: J; Joule, DMI; Direct Material Input

# Ⅳ. Eco-Efficiency Indicator

■ Significant differences between Tables 1 and 2

- indicators can be selected differently.
- the sources arising the difference

- . the stated goal
- . methodology adopted
- . framework designed for the development of indicators, etc.

# Ⅴ. Conclusion - The Implications of Eco-Efficiency

## 1. Ideological Implications

■ traditional approach

- before the 1960s: traditional industrialization without concern on environment
- The 1970s: development of national economy with *ex post facto* response to environment
- The 1980s: environmentally friendly national economy with an expansion of *ex post facto* response to both environment and consumption
- The 1990s - the early 2000s: precautionary policy of national economy with both *apriori* and *ex post facto* response to environment

# Ⅴ. Conclusion - The Implications of Eco-Efficiency

■ eco-efficiency

- not simply an environmental management
- is an integrated approach to both economy and environment as an integrated system

# Ⅴ. Conclusion - The Implications of Eco-Efficiency

## 2. Practical Implications

■ considering appropriate carrying capacity of nature

■ self-reflection on the existing market based on market-priced paradigm characterized as that

- market price is determined by production and consumption
- ecological cost is not included in market price
- difference arises between market price and ecological cost
- the most efficient activity in terms of market price is the worst activity in terms of ecological cost
- from a long-point of view, eco-efficiency paradigm would be beneficial than market-priced one for sustainable development through the harmonization of economy with ecosystem

# Ⅴ. Conclusion - The Implications of Eco-Efficiency

## 3. Implications for Local Economic Development

■ eco-efficiency principles are more profitable and competitive in that they
- use less virgin resources, water and energy,
- generate less waste and pollution,
- improve production methods,
- develop new products or services,
- use or recycle existing materials, etc.

■ core focus: how to reduce the current gap between market price and ecological cost

■ development of indicators
- on the base of the stated goal and methodology
- but, different indicator by region sector

■ construction of the indicators as a database for
- identifying, measuring and evaluating the current state and change
- supplementing and/or revising the methodology

# Ⅴ. Conclusion - The Implications of Eco-Efficiency

## 4. Practical Approach to Local Economic Development

■ step-by-step approach

- 1st: improvement in the process of production
  (reduction of production cost)
- 2nd: development of new environmentally friendly product
  (increase in profit)
- 3rd: change of market mechanism
  from material goods-based one
  to service-creation opportunity one (reduction of
  material use and change in consumption pattern)

# Ⅴ. Conclusion - The Implications of Eco-Efficiency

■ Construction of governance system for drawing social consensus among interest groups involved in eco-efficiency

- . local government
- . business corporations
- . civic organizations
- . stakeholders
- . citizens
- . expert groups

# Ⅴ. Conclusion - The Implications of Eco-Efficiency

**5. The Comprehensive and Ultimate Implication**

- environmentally sound,
- and humanly desirable

***Many Thanks for Your Listening!!***