

SUSTAINABILITY SCIENCE

- A Transdisciplinary Approach for Key Issues in the 21st Century -

Susumu Iai

Director, Sustainability Science Kenkyu-Yunitto, Kyoto University

Professor, Disaster Prevention Research Institute, Kyoto University

Gokasho, Uji, KYoto 611-0011 Japan

Tel/Fax: 81-774-38-4090/4094, E-mail: iai@geotech.dpri.kyoto-u.ac.jp

1. BURDEN ON THE LIMITED EARTH

After the creation of the Earth 4.6 billion years ago, chemical reactions produced organic molecules, which led to a crude form of a life four billion years ago. Human beings that evolved from primates four million years ago increased their population to five million by innovation of stone implements and further five hundred million by innovation of agriculture. During the ensuing ten thousand years, a period of little technological innovation, the population remained stable. The industrial revolution 200 years ago triggered a population explosion that reached six billion. Technological revolution in the 20th century led to further population growth, reaching ten billion within fifty years due to these technological and scientific developments. This growth, in turn, created an excessive burden on the limited earth resources and posed threats to sustainability of humans. In fact, the humanity's burden has already exceeded the earth's biological capacity by about 20 percent as shown in Figure 1.

The future of the earth and humans depends on our approach to solve these problems.

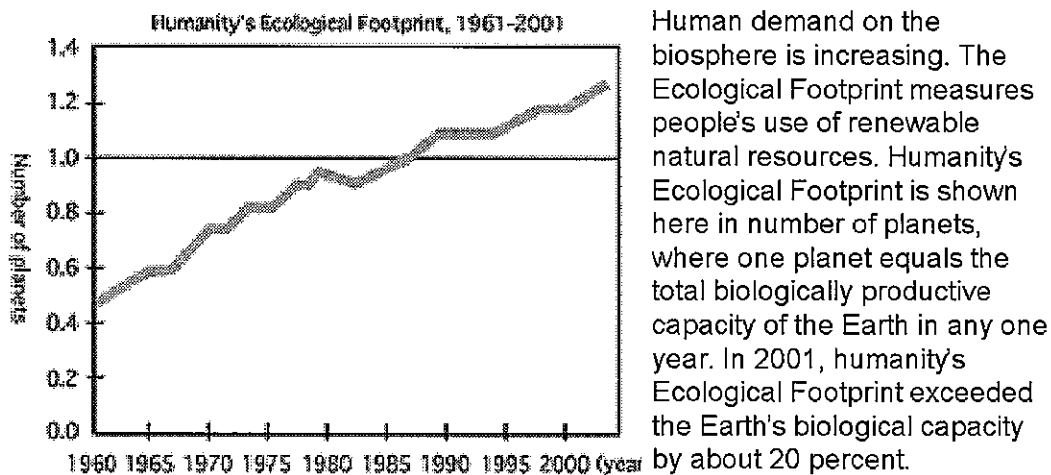


Fig. 1 Humanity's ecological footprint, 1961-2001 (WWF, Living Planet Report, 2004)

2. RESEARCH PROGRAM IN KYOTO UNIVERSITY

The Sustainability Science Kenkyuu-Yunitto (i.e. transdisciplinary research center) was established in Kyoto University in April 2006 to solve these problems. This institute is organized by the Institute for Chemical Research, Institute of Advanced Energy, Research Institute for Sustainable Humanosphere, Disaster Prevention Research Institute, and Center for Southeast Asian Studies; altogether these institutes encompass more than three hundred faculty members performing cutting edge research in their specific areas. The research in the Sustainability Science Kenkyuu-Yunitto will be transdisciplinary and performed in a problem-oriented manner.

Technological revolution in 20th century was based on the cutting edge approach that deepens the knowledge in a limited and specialized scope. Humans obtained vast scientific knowledge and achieved the technological revolution through this approach. This approach, however, produced a trend that the cutting edge knowledge is shared only by an exclusive group of specialists. In order to solve the key issues in the 21st century such as global sustainability, we need to expand our scope from the conventional and diversified disciplines. Expansion of our scope and taking a global view will be the basis for better defining the key issues in the 21st century.

3. EXAMPLES OF RESEARCH AREAS

Examples of research areas in the sustainability science are shown in Figure 2. The aspects of global environment such as climate change and recycling resources are shown in the inner circle. The primary research areas of the sustainability science are shown around those aspects of global environment. Specific examples of research subjects are shown in the outer circle.

The examples of research areas that could be directly expanded from the discipline of disaster mitigation and management may be environmental risk management and recycling resources. An informatics platform that will serve as the lifeline of sustainability science is also essential for achieving comprehensiveness in the study of sustainability. The knowledge established in the informatics for risk management may be directly expanded into the informatics platform needed in the sustainability science.

Irrespective of the research areas defined for the study, a wider scope of research that encompasses the areas of different disciplines is essential in the sustainability science.

4. APPROACHES IN SUSTAINABILITY SCIENCE

The research areas in the sustainability science depend on the spatial scale. It is important to identify the spatial scale of the system such as global, regional, and human systems and the relations between these systems.

Finding the sequence of events is also important to identify the dynamics of a system. Differentiating the positive from the negative sequences could lead a strategy to achieve a sustainable society.

Identifying the dynamics of concentration and dispersion of social system and natural resources is essential

to establish harmonic societies. Finding the relations between the social system and technological strategy is also important.

Since the humanity's burden has already exceeded the earth's biological capacity as discussed earlier, the global system may be in the critical condition. Studying the vulnerability and robustness of the social and ecosystems is important to find a strategy to achieve global sustainability.

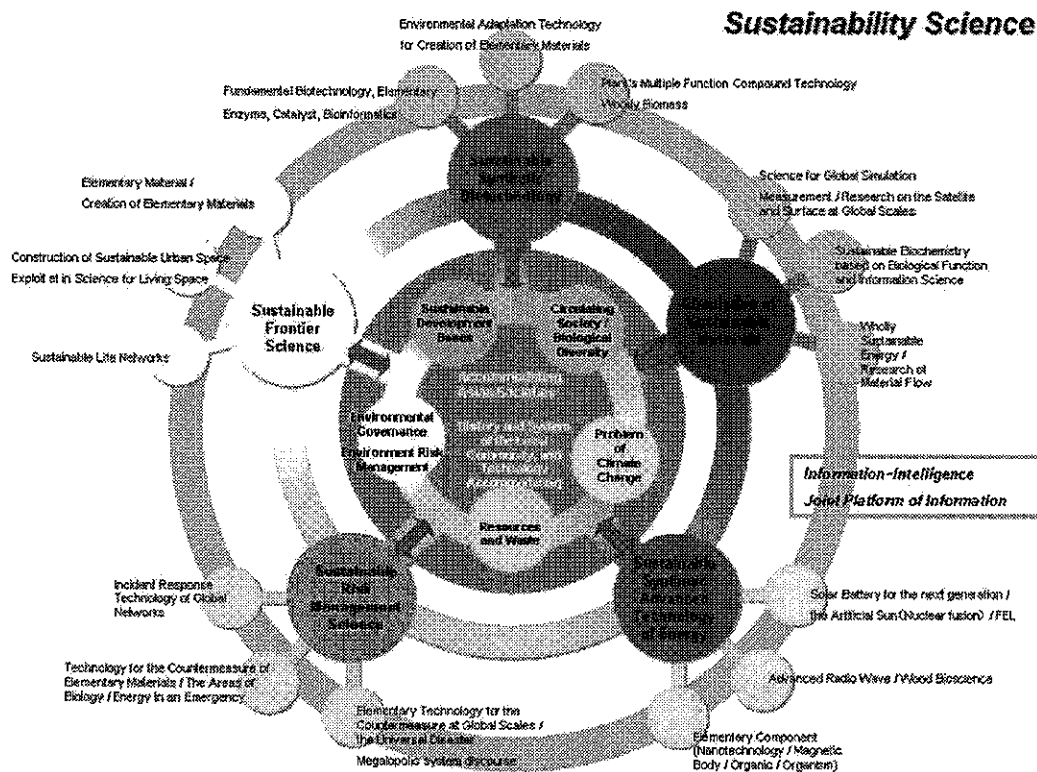


Fig. 2 Sustainability Science

5. REFERENCE

WWF, Global Footprint Network (2004): Living Planet Report 2004, Switzerland

About the author

IAI, Susumu

IAI Susumu is professor of Disaster Prevention Research Institute, Kyoto University. He graduated from the University of Tokyo in 1974. His major research interests are geotechnical earthquake engineering in waterfront areas, including soil-structure-fluid interaction analysis. He has been chairman of PIANC/MarCom/WG34: Working Group on Effects of Earthquakes on Port Structures, International Navigation Association (PIANC), 1997-2002, and convener of ISO/TC98/SC3/WG10: Seismic actions on geotechnical works, ISO, 2002-present. He received 1994 Award for outstanding research accomplishment (Japanese Geotechnical Society), 1994 Prakash Award for significant contribution to geotechnical earthquake engineering (Prakash Foundation, USA), 1996 Award for outstanding research accomplishment (Science and Technology Agency, Japanese Government), and 1999 Award for outstanding paper award (Japanese Geotechnical Society). He was appointed as director of the Sustainability Science Kenkyuu-Yunitto established in 2006 in Kyoto University.