MULTIDISCIPLINARY APPROACHES TO NEW PATHWAYS TO SUSTAINABLE DEVELOPMENT

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Summary

Sustainable development is a highly integrated concept, while realization of sustainable development is a comprehensive multidisciplinary process involving coordination and function. The implications and implementation of sustainable development should be studied from multidisciplinary angles, including the ecology, economics, the social sciences, and technology.

From the viewpoint of ecology, sustainable development depends on healthy ecosystems, while it is impossible to deal with the degradation of ecosystems with knowledge of a single subject.

From the viewpoint of economics, sustainable development means a new understanding about traditional economic measures of gross national product and standard national accounting. Improvement of resource pricing and economic accounting is one of the key

issues, but this process does not concern only economics, it also involves multidisciplinary knowledge.

From the viewpoint of technology, the key issue is how to understand, master, develop, and apply science and technology correctly to improve living standards and increase welfare and therefore improve sustainability of development. Cleaner production, in which multidisciplinary efforts are also reflected, is both an idea and a tool to promote sustainability.

The process of setting up and monitoring the indicators of sustainable development also needs multidisciplinary knowledge.

1. Introduction

Sustainable development has recently become a very important theory for countries all over the world to deal with the relationship between the environment and development and has penetrated into all aspects of our life. Sustainable development is a highly integrated concept, which involves many subjects, such as economics, social sciences, culture, technologies, natural resources, and environmental fields, while realization of sustainable development is a comprehensive multidisciplinary process involving coordination and function.

Sustainable development does not refute economic growth, especially the economic growth of poor countries. However, how to promote and realize economic development should be further studied. Based on natural capital and ecosystems, sustainable development must be coordinated with the carrying capacity of the environment and aim at improving life quality and advancing society. Meanwhile, implementation of sustainable development needs a proper policy and legal system, in which integrated decision making and public involvement should be emphasized.

In addition, in view of intergenerational and intra-generational equity, sustainable development should not only take into consideration the conflict and coordination of population, resources, the environment, and development in one country or one generation, but also the conflict and coordination of population, resources, the environment, and development between different countries and generations.

The Brundtland Commission of the World Commission on Environment and Development issued *Our Common Future* in 1987, and in this the concept of sustainable development was first raised as “development that meets the needs of the present generation without compromising the ability of future generations to meet their needs.” This definition gained broad acceptance, though some argue that this definition is more philosophical than practical. Consequently, many researchers and international organizations carried out studies on sustainable development from different angles. For

example, from the viewpoint of ecology, sustainable development can be defined as *improving life quality without exceeding the carrying capacity of ecosystems*. From the viewpoint of economics, sustainable development can be defined as *maximizing net benefit of economic growth while gaining service from natural resources continuously*, or *development and environmental policies that are based on cost-benefit comparison and deliberate economic analysis, reinforcing environmental protection, resulting in increasing welfare and improvement of the level of sustainable development*. From the viewpoint of technology, sustainable development can be defined as *establishing technological and technical systems that minimize wastes and pollutants*. There are even more definitions of sustainable development from different points of view.

Studies of these definitions and discussions show that sustainable development has implications of great affluence. It is both target and measures to achieve the target, and it emphasizes protection of resources and the environment in parallel with economic and social development. Each definition studies the conditions and ways of implementing sustainable development from the angles of different subject and forms different knowledge of sustainable development.

To sum up, the implications and implementation of sustainable development can in no sense be studied from the viewpoint of a single subject; rather, it should be studied from multidisciplinary angles, such as ecology, economics, the social sciences, and technology.

2. The Ecology and Sustainable Development

What does sustainable development have to do with ecology? From the viewpoint of ecology, sustainable development depends on healthy ecosystems. All our economic systems, our life-support systems, and our quality of life depend on continuous and adequate functioning of the earth's ecological system. From a very broad point of view, the existence and development of human beings are maintained by the water cycle, biogeochemical cycle, climate system, biodiversity, and a well-functioning ecosystem. To sum up, ecosystems mainly include the following:

- Providing vital resources for human activities: in fact, natural ecosystems of the earth—living organisms interacting with each other and their physical environment—provide humans with a vast array of marketable ecosystem goods, such as seafood, forage, timber, many industrial products and their precursors, and also soil and production and recovery of soil fertility, and biodiversity including diversity of genes.
- Providing a life-support system: ecosystems also provide services that are fundamental parts of our life-support system, including purification of air and water, detoxification and decomposition of waste, stabilization and moderation of the earth's climate, moderation of floods and droughts, generation and renewal of

soil and soil fertility, etc.
- Eliminating and assimilating wastes and waste energy produced from human activities and environmental capacity, including purification of air and water, detoxification and degradation of waste, etc.
- Providing spaces for living.
- Providing amenity and aesthetics, etc.

Sustainable development must be established in stable functioning ecosystems, especially those subsystems that are vital to human existence. However, human activities have placed great pressure on the environment in recent years. Accordingly, those anthropogenic environmental problems, especially global environmental problems, are now seriously affecting the normal functioning of ecosystems and thereby affecting international economic and social development. These problems mainly include climate change, ozone depletion, ocean pollution, loss of biodiversity, desertification, soil degradation, destruction and degradation of freshwater and forests, and accumulation of persistent pollutants in the environment.

All of the above problems have destabilized the earth's biogeochemical system and thereby threatened sustainable development. To solve these problems, knowledge of a single subject is not sufficient. Multidisciplinary efforts are needed. Global climate change can be an example. Scientific evidence shows the impact on climate systems of anthropogenic activities and the cumulative effects, and thereby the impact on the biosphere and human beings. Economic analysis shows the probable costs and benefits of climate change and compares the cost effectiveness of different climate mitigation options. Development of technologies improves new energy-saving technologies and development of new energy sources, including new burning technologies such as Integrated Gasification Combined Cycle (IGCC) and some others that are still in the conceptual stages. Moreover, people have realized that these problems can not be solved merely by technological advances. From the viewpoint of social science, irrational production and consumption patterns under different societal conditions should be studied to provide new ideas on energy consumption and lifestyles. These new ideas are very important for solving the problems.

Similarly, study of and solutions to other environmental problems, especially global environmental problems such as ozone depletion, loss of biodiversity, and degradation of forests, also need multidisciplinary efforts.

3. Economics and Sustainable Development

From the viewpoint of economics, sustainable development means a new way of thinking about the traditional concept of economic growth and capital, a new understanding about traditional economic measures of gross national product and standard national accounting.

Traditionally, attention to development has been constrained to activities within economic fields and has not taken into consideration the externality of economic activities—depletion and damage of economic activities to the environment and natural resources. One reason is that what economic growth was concerned with was only produced capital, while the importance of natural capital and human capital in economic development was overlooked. Actually, both natural capital and human capital are very important to economic development in addition to produced capital. For instance, natural capital provides raw materials and the capacity to eliminate wastes, while human capital proves to be a crucial part of capital and resources for development.

Past experiences shows that economic growth is necessary but not sufficient to development. If damage to ecosystems by economic activities is not taken into consideration, then the carrying capacity of biological systems will be destroyed and thereby sustainability of economic development will be damaged along with the damaged ecosystems. Consequently, one important step is to consider rational pricing of natural resources and calculation of marginal social costs of pollution on the basis of a new understanding of what constitutes capital. In traditional standard national accounting, the value of natural resources and ecosystems, cost of environmental pollution, and depletion of resources are not adequately considered due to its limitation to purely economic analysis. Currently, discussions focus increasingly on modification of accounting systems. This process does not concern only economics, but also involves multidisciplinary knowledge.

One example is resource pricing and economic accounting. Many economists, ecologists, and ethicists are involved in the discussion about resource pricing and economic accounting. They have broken down the traditional theory of economics and consider the issues of resource pricing, trying to make prices reflect the value of resources and damage to environment by resource exploitation. Of the theories of natural resource pricing, the theory of marginal cost pricing is well accepted. According to this theory, the resource price paid by users should equal the cost of natural resource exploitation and depletion that is now undertaken by society and the cost of corresponding environmental damage. To sum up, the full price should include cost for resource proving and exploitation, cost of environmental damage and recovery cost, etc. Employing this theory, a comparatively rational pricing system can be set up.

Currently, a series of research frontiers reflect the function of economics in sustainable development, including measurement and evaluation of natural resources, economics of sustainable agriculture, simulation of ecological-economic systems, policy implications of ecological-economic analysis, ecological-economic solutions to environmental degradation, ecological valuation, resources accounting, environmental rights, and environmental taxes. This research and its contribution to sustainable development should also be multidisciplinary.

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Biographical Sketches

Xueyang He has been a Ph.D. candidate in the Department of Environmental Science and Engineering in Tsinghua University, Beijing, since September 1996, having graduated from the same department in 1996.

Kunmin Zhang graduated from Tsinghua University, Beijing, in 1963, and completed his postgraduate training in Tsinghua University in 1966 (at that time there were no degrees in the People's Republic of China). Then he became a teacher in the same university and occupied the position of vice dean of the Department of Civil Engineering and Department of Environmental Engineering. Professor Zhang was appointed vice president of the National Training College of Environmental Management in 1985. From 1988 to 1998, he was deputy administrator of the National Environmental Protection Agency (NEPA). He currently holds the positions of secretary general of the China Council for International Cooperation on Environment and Development (CCICED), senior advisor of the State Environmental Protection Administration (SEPA), vice president of the China Sustainable Development Association, honorary chair of the Environmental Literature Association, professor with Peking University, Tsinghua University, China People's University, Nanjing University, etc.

Professor Zhang has compiled nine books, translated or collated 11 books, and published over 90 papers.

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