KNOWLEDGE FOR SUSTAINABLE DEVELOPMENT

N.V. Belotelov
Center for Ecology and Forest Productivity, Russian Academy of Sciences, Moscow, Russia

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Summary

Knowledge for sustainable development may be divided into biophysical and ecological knowledge and knowledge of the socioeconomic organization of human society. Biophysical and ecological knowledge may be subdivided in the following manner: knowledge concerning biogeochemical cycling and energy transformation in the biosphere and ecosystems; and biologic regularities in natural life such as a population–communities approach for describing ecosystems organization, including principles of evolution. Knowledge of the socioeconomic aspects of human society is a very important part of knowledge for sustainable development with regard to the rapid growth of human populations, production, and energy consumption around the world destroying the natural ecosystems and destabilizing the biosphere as a whole. The methodology of industrial ecology is to recognize different measures for critical thresholds of interactions between production processes and the environment and human health. It is very important to stress that knowledge must be collected corresponding to definite spatial temporal scales.

To a degree, the huge amount of biophysical, ecological, technological, social, and economical knowledge we have on sustainable development can explain how the current environmental situation has been created by human civilization. However, this does not allow us to predict future environmental situations in any detail. Therefore, as a matter of urgency scientists must investigate the links between different fields of knowledge of sustainable development.

1. Introduction

The notion of sustainable development came into being towards the end of the twentieth century. It reflects the deep anxiety of many people around the world about the future of human civilization. The rapid changes in all aspects of our lives in a single generation emphasize the problems for which there has been no satisfactory solution until recently, that were global not local in character, and that are very complex.

Sustainable development includes interrelated problems such as rampant population growth, degradation of natural ecosystems, diminishing biodiversity, increasing poverty in the developing countries, growth of new diseases, exhaustion of nonrenewable resources, and climatic changes. A considerable number of changes are occurring in the world during the lifetime of a single generation and these are very rapid. They are taking place at an exponential rate because human beings attempt to dominate the accessible ecological niche in its entirety. Such behavior is in conflict with resource restrictions. This contradiction is the core of the problems of sustainable development. There are no universal solutions for such complex problems. Any solutions are themselves a process and can take a generation to run their course. This determines the following circumstances. First of all, humanity does not understand biosphere organization in detail; in other words, we do not really know how the biosphere works. This is because of differences in the time changes in natural ecosystems take and the lifetime of a single human generation. On the other hand, humankind does not fully understand its "social–cultural dimension." Humanity lives captive to stereotypes about interactions between biosphere and civilization. Human beings differ from other large mammals not only in having the opportunity to conceive and generate incorrect information but also in being able to believe in myths and to formulate illusions. And, above all, in being able to operate according to incorrect information. Human beings view the universe through spectacles of existing conceptions but these conceptions have changed throughout history.

It must first be stressed that there are two spheres: the biosphere and the socioeconomic sphere. In spite of their close connection, they have their own regularities. The biosphere may be subdivided into the atmosphere, lithosphere, hydrosphere, and biota. The socioeconomic sphere may be divided into the production sphere (technology and resource consumption) and human society (consumption of goods and the principle of authority in social organization). Knowledge of each is different but they are closely connected in the real world. Appropriate knowledge is necessary for solving the problems of sustainable development but the amount of knowledge available is increasing dramatically.

Knowledge about the interaction between civilization and the biosphere and between different parts of biosphere as well as knowledge about society is incomplete and far from perfect. The role of education is increasing as a mechanism of knowledge transfer from one generation to another. It is assumed that in future the education process and the process of knowledge generation will be closely connected because of the increasing rate of environmental change. The ability to achieve sustainable development depends on scientific knowledge of the earth's natural systems and the ways in which human activities affect these systems. Accurate information based on scientific research

establishes the foundation of knowledge needed for sound decision making by individuals, businesses, government, and society as a whole. Baseline scientific data are essential for developing community-based sustainable development strategies.

Human beings understand the universe to be a system of natural processes with a clear historical development. There are many specific "parametric spaces" by which environmental processes and human society are described, for example, "physical-chemical space," "biological space," "sociological space," and so on. Regularity that occurs in one parametric space usually does not transfer to another space. Indeed this situation is quite similar to the principle of uncertainty in quantum mechanics. There is no universal parametric space by which to describe nature, human society, and interactions between them. This principle of observation superimposes strong restrictions upon the process of knowledge accumulation and transfers it to future generations. From this point of view the following structure of knowledge for sustainable development can be proposed.

According to this subdivision of the world into a biosphere and a socioeconomic sphere, knowledge for sustainable development may be divided into biophysical and ecological knowledge, and knowledge of the socioeconomic organization of human society. It is important to stress that knowledge must be collected corresponding to definite spatial temporal scales. Biophysical and ecological knowledge may be subdivided in the following closely connected manner: knowledge about biogeochemical cycling and energy transformation in the biosphere and ecosystems; and biologic regularities in natural life such as a population–communities approach for describing the organization of ecosystems including the principles of evolution. Industrial ecology is based upon the methodology of recognizing different measures for critical thresholds of interactions between production processes and the environment and human health. Knowledge of socioeconomic aspects of the organization of human society is very important for sustainable development with regard to the way the rapid growth of human populations, production and energy consumption around the world is destroying natural ecosystems and destabilizing the biosphere as a whole.

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Biographical Sketch

Dr. Nickolay Vadimovich Belotelov, born July 26, 1959, graduated from Moscow Institute of Physics and Technology in 1982 and presented his Candidate of Science thesis "Mathematical models of the spatially distributed ecosystem" in 1985. He was a research associate at the Computing Center, Russian Academy of Sciences, Moscow (1985–1992); a senior research associate at the Center for Ecology and Forest Productivity Problems, Russian Academy of Sciences, Moscow (1992–1999); and since 1999 has been with the Department for Problems of Sustainable Development at the Mendeleyev University of Chemical Technology of Russia.

His field of scientific interest is mathematical modeling in ecology. He has worked in different fields of mathematical modeling in ecology: population dynamics; carbon cycle modeling on a global scale; landscape dynamics; mathematical modeling of vegetation dynamics under climate and anthrophogenic impacts on regional and global scales. Several works connected with investigating the stability and bifurcation in the ecosystem models of the "reaction-diffusion" type have been done. He took part in the investigation of the ecological and demographical consequences of nuclear war. He developed a bioclimatic dynamic approach for assessment of time-dependent vegetation shifts on a global scale under climate changes. The results of his scientific work have been printed in more than 50 publications.