

Evolutionary and historical thinking on human-nature interactions as a basis of sustainability science

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First, I briefly review current status and trends of biodiversity in the Asia-Pacific region. Tropical Asia is known as a global center of species richness of vascular plants, land vertebrates and marine organisms. At the same time, this is the area where forest loss is most rapid and also where loss of coastal environments is most serious. Thus, the rate of species loss may be high. Unfortunately, we do not have reliable estimates of species loss and associated loss of ecosystem functions. Under the Asia-Pacific Biodiversity Observation Network, a project is now going on to estimate the rate of biodiversity loss, identify hotspots and prioritize conservation actions.

Second, I review the history of human-nature interactions since our species started the migration from Africa to Europe and Asia about 60,000 years ago. This historical perspective will be useful to forecast future changes of human-nature interactions and to develop innovative social responses to achieve global sustainability. During the human migration, our species first terminated many big mammals, including the mammoth. Later, our ancestors became hunters of smaller mammals, and also caught fish and shells, and consumed more plants. Resource use in the hunter-gather societies is mostly identical with optimal patch use strategies of many animals, except in using advanced tools of hunting and gathering that make it easier to terminate local populations of wild organisms. Under interactions of increased human density, local resource depletion, and climate change, our species developed, or evolved, agriculture. Agriculture is the product of evolution in its strict sense because there is a growing body of evidence that modern humans are genetically adapted to agriculture. Agriculture was the first activity of biodiversity protection in that many species were preserved under cultivation or domestication for human use. During the expansion of agriculture, forest areas were decreased and then silviculture was developed because woods are a critical resource for fuel and also for making houses, wheels, ships, etc. This situation was changed drastically by the industrial revolution which enabled us to use fossil fuel instead of wood, and to make wheel and ship with iron instead of wood. Simultaneous development of regional and global markets drove trades of increasing amounts of agricultural products and decreasing amounts of wild biodiversity resources. After the World War II, and especially over some recent decades, this trend has been continuously accelerated in Asia, where many countries have been economically developed and human populations have continuously increased.

It is often claimed that the Asia-Pacific region offers many examples of long-term social and ecological sustainability, including many traditional systems of agriculture and livelihood that have supported large numbers of people through time. In Japan, for example, the traditional agricultural land use in “Satoyama” is considered to be an example of a sustainable system. On the other hand, we are facing a fact that many species are being lost in Japan and forest loss is most rapidly going on in the Asia-Pacific region. This is because many traditional systems of agriculture and livelihood are economically inferior to more efficient production systems under the modern market mechanisms. Traditional culture such as “gift from nature” and “harmony with nature” type thinking is too weak to resist market mechanisms, although it might get sympathy of many people.

Attempts at valuing ecosystem services are being made as a way to use market mechanisms for enhancing sustainability. In addition to these attempts, the recent disasters could provide us a new key to change the current value system. We are facing a fact that disasters are unavoidable during a long geological time and a need to create a society that can recover from disaster quickly under a long-term sustainable system. It is notable that ecosystems have high resilience, and this resilience is supported by species diversity that appears to be redundant in a short-term dynamics. Natural ecosystems can recover from large disturbance without any economic investment. Further, even if environments are changed, genetic variation ensures most organisms can adapt to new environments by evolution. In other words, biodiversity has long-term values for sustaining ecosystem services. Because long-term values are hardly evaluated under the modern market mechanisms, we need some innovations to overcome this drawback.

In conclusion, our species evolved agriculture and sophisticated culture by utilizing various biodiversity resources, but its dependence on biodiversity is declining since the industrial revolution through the rapid and continuing development of trades and markets at regional and global scale. However, the long-term persistence of our species critically depends on biological resources; not only on crops and cattle but also diversity of evolving wild species that ensures resilience of environments, and resilience of our society under various disturbances including disaster. Now, the time is right to reform our social systems to preserve the long-term value of biodiversity as a basis of sustaining our species.