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Comparison of ecosystem networks in Mongolia grassland and Malaysia forests

Norio Yamamura[1]*

[1]Res. Inst. for Humanity and Nature

Remarking specially the network structure of social-ecological systems, we are executing a project titled 'Collapse and Restoration of Ecosystem Networks with Human Activity' (http://www.chikyu.ac.jp/rihn e/project/D-04.html) in Research Institute for Humanity and Nature (http://www.chikyu.ac.jp/index e.html). 'Ecosystem Network' is the key concept that we propose newly in this project. It is the social-ecological system where network of ecological subsystems characterized by land-cover or land-use, such as grassland, forests, rivers, agricultural fields and mine areas, with human network affecting quality of and transition among the subsystems. The usefulness of this concept is to see the human impacts through changes in land-cover, of which data are available from statistics, field survey and satellite information.

Field research takes place in tropical rainforests in Sarawak, Malaysia, and grasslands of Mongolia. In the last few decades, social and environmental conditions in both places were profoundly affected by resource extraction, which has recently intensified in relation to demand from global economy. Though their ecological characteristics, such as the regeneration time of vegetation and position of humans in the food web, are quite different, the livelihoods of many inhabitants of these regions are dependent on natural ecosystems.

In Mongolia, we: (1) found the most serious environmental problem to be increased degradation of pastures, especially near Ulan Bator, caused by overgrazing by an increasing number of livestock, especially goats; (2) studied the social patterns leading to concentrations of livestock to urban areas; (3) analyzed climate data in order to clarify the roles of forests and shrubs in maintaining sustainable pastures; and (4) conducted scenario analysis of the effects of several options, such as restriction of the number of livestock and restriction of the movement of livestock through privatization of land, on pasture degradation.

In Sarawak, we: (1) found the most serious environmental issues to be the mass logging of forests and expansion of palm plantations, and their negative effect on biodiversity and forest resources available to inhabitants; (2) conducted questionnaire surveys along the Rajang and Baram rivers, two main rivers in Sarawak, in order to identify the reasons; (3) examined biodiversity patterns of several plants and animals depending on human activities; (4) analyzed the effectiveness of, and problems with, institutions and systems such as forest certification and bio-prospecting in regulating rapid plantation developments.

Finally, we have begun to develop a general theory of conservation of ecosystem networks. In this process, we found that the networks have remarkable difference between grassland and forest systems. This is based on differences in economic properties for humans in the two ecosystems. In Mongolia, the vegetation itself (grasses) has no direct value for humans; the value is stored in livestock that feeds on the grasses. Therefore, global economy affects the behavior of inhabitants, leading to overuse of the vegetation and degradation of the grassland. In this case, the effective solution to the problem should involve changing the behavior of inhabitants. On the other hand, in Sarawak, the economic value is stored in the vegetation (trees). Therefore, enterprises and governments tend to severely develop the forests, causing both reductions in the amount of forest available to inhabitants and biodiversity loss. The effective solution here should involve regulation of enterprises and governments. We are exploring a mathematical model representing the difference of networks, and examining effective strategies for sustainable management of the systems.

Keywords: Ecosystem network, Mongolia grassland, Malaysia rain forests, Scenario approach, Network conservation theory