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## **Different Social-ecological Networks in Grassland and Forest Systems Implication for their sustainable management**

Many ecosystems have been seriously degraded by human activities in the world. In order to consider management of those systems, we should grasp the systems as social-ecological networks as a whole. 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/rihne/project/D-04.html>) in Research Institute for Humanity and Nature (<http://www.chikyu.ac.jp/indexe.html>).

We found that the networks have remarkable difference between grassland and forest systems, by analyzing data from grassland in Mongolia and forests in Sarawak, Malaysia. 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 here explore the model representing the difference of networks, and examine effective strategies for sustainable management of each type of systems, using the model. In Mongolian social-ecological system, the equilibrium is always stable even if price of livestock products increases because of negative feedback between grassland quality and livestock biomass. However, considering climate fluctuation of grassland quality, the risk of system collapse is lower for the higher equilibrium value. In Sarawak social-ecological system, when logging rate reflecting global economy exceeds a critical level, usable forests for inhabitants rapidly decreases to 0 because of positive feedback between decreases of such forests and inhabitant utilization activity for forests. The system has the essential nature of instability. We discuss that general social-ecological systems with environmental problems can be placed at some positions between two types of Mongolia and Sarawak networks.