



A new mathematical model for sustainability analysis of various ecosystem-society interactions under the global change

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Most ecosystems on earth have become seriously degraded due to human activities. To understand the mechanism of the degradation by ecosystem overuse, a new mathematical model was developed to understand the complexity and stability of interactions among ecosystems and human societies. The model has a simple network structure with the dynamics of ecosystem resources (ER), local peoples' population (LP) and enterprise size (ET) which are linked to one another with flows of biological resources and the derived economic values. In this presentation the basic concept and the preliminary results about the conditions for sustainable coexistence of the three components under various ecosystem conditions are demonstrated, where two specific example cases with contrasting ecological settings, grassland ecosystem in Mongolia and tropical rainforest ecosystem in Malaysia, are highlighted. It had been found by previous studies that these two ecosystems exhibit clear qualitative difference in the relationship between the ecosystem resource users (i.e. local people and enterprises), that is, cooperative in the former type and competitive in the latter. Model analysis have been conducted varying conditions of the ecosystem and its users. From the analysis, it was suggested that the ecosystem properties about utility (e.g., primary production and accessibility to ER) is the key to determine the network structures. In the grassland type network (with poor utility) the resource use is mostly under negative feedback control by the local users and thus is more sustainable against increased demand. On the other hand, in the tropical forest type (with rich utility) it is unlikely to sustain both of the ecosystem resource and local people unless introducing strong negative feedback mechanism for the enterprise use. For further discussion, we expand the typology of the ecosystem network including aquatic ecosystems to provide a general theoretical framework.