Under what conditions can biodiversity resource use be sustainable?
A theory and an example in Borneo

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I studied relations among land use patterns, biodiversity, and wild plant use in a village of the Iban conducting shifting cultivation in Sarawak, Borneo.

The villagers used plants common in secondary forests for foods and materials consumed in everyday life and plants found in primary forests for enchantments or constructions during rare events or crucial moments. Such differences were also reflected in folk tails and naming systems of wild plants.

In general, biodiversity was much higher in primary forests. However, secondary forests were rich in species with frequent reproduction and higher values of "r" (potential population growth rate). Thus, plants in secondary forests hardly become extinct even under intensive use. If primary and secondary forests are neighboring, flora of the latter became richer affected by the former. Because people walk around secondary forests much more frequently, some rare species were also collected mainly from secondary forests neighboring to primary forests. Thus, populations of useful rare species in primary forests, which are seed sources of the populations in secondary forests, are kept intact.

It was theoretically suggested that if people have sufficient knowledge about plants and animals, biodiversity tends to promote sustainability of wild plant and animal use without any contradictions with short-term benefits of individual persons.

To demonstrate it, I examined effects of resource selection by people in logistic models without inter-species competitions and lottery models with competitions. In both cases, density dependent resource selection (DDRS) plays an important role. DDRS works when species-specific skills are required, qualities of materials should be uniformed, and resources are weakly habit-forming for people.

In non-competitive models, overuse causes extinction. Even without overuse, if the population becomes smaller than the threshold by accident, resource use must be stopped to avoid extinction. DDRS enables automatic choice of species of which overuse hardly occurs and resource switch when the resource species accidentally decreases. In competitive models, if DDRS works, resource use becomes more often sustainable than when a single species is used or all species are used evenly, and DDRS reduces the probabilities of extinction of rare species than natural conditions.

From the above-noted reasons, community based resource managements and resource privatizing as the solutions to avoid tragedy of commons are not required in species rich areas unless wild plants or animals are commercially traded.