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Segregate or integrate nature and agriculture for biodiversity conservation? Criteria for agroforests

Meine van Noordwijk[1], Carel van Schaik[2], Hubert de Foresta[1,3] and Thomas P. Tomich[1]

1. ICRAF-S.E.Asia, P.O.Box 161, Bogor 16001, Indonesia
2. Centre for Tropical Conservation, Duke University, Durham, USA
3. ORSTOM

Abstract

Human use of biotic resources ('agriculture' in its widest sense) and biodiversity ('nature' in its widest sense) are both needed by society at large, but there are generally conflicts between these two aspects of 'land use'. Conflicts between 'nature' and 'agriculture' can be solved by *segregating* nature and agricultural land (maximizing agricultural production on a relatively small part of the land will leave as much land for nature as is possible) or by *integrating* nature into agricultural land through the adoption of production systems that allow sufficient agricultural production while ensuring conservation of considerable parts of the biodiversity of the natural system. Multi-functional forests and agroforests are examples of the 'integrate' option, intensive agriculture plus nature reserves are an example of the segregate pathway. Mixed strategies are feasible where nature reserves coexist with pure agricultural production systems for some commodities and where production systems integrate nature and agriculture for other commodities. All three options have strong advocates, and it is not clear which solution is optimum under which conditions. Objective criteria are needed for distinguishing which solution may best meet the multiple goals formulated under different circumstances.

A simple model is used to derive a decision scheme. It distinguishes 'internal' biodiversity of a land use system and 'external' biodiversity, by requiring only a part of the area for agriculture. If two production systems are compared, biodiversity conservation will be maximized if the system is chosen with the highest agricultural productivity per unit biodiversity loss. If agricultural intensification is treated as a continuous process, a similar criterion can be used to distinguish between situations where 'segregate' or 'integrate' forms the best solution. Further research is needed to check the assumptions behind the proposed

equations, to quantify the scaling function of biodiversity in order to assess the effectiveness of both 'internal' and 'external' biodiversity conservation, and to determine the feasibility of implementation of options in the 'real world'.

Introduction

Human use of biotic resources ('agriculture' in its widest sense) and biodiversity ('nature' in its widest sense) are both needed by society at large, but there are generally conflicts between these two aspects of 'land use'. Conflicts between 'nature' and 'agriculture' can be solved in three ways:

- by *segregating* nature and agricultural land; maximizing agricultural production on a relatively small part of the land will leave as much land for nature as is possible,
- by *integrating* nature and agricultural land through the adoption of production systems that allow sufficient agricultural production while ensuring conservation of a considerable part of the biodiversity of the natural system,
- by segregating nature and agriculture for some production systems and integrating it for others.

It is important to notice that the area available for complete protection of biodiversity decreases when agriculture remains below its potential productivity under the integration option. All three options have strong advocates, and it is not clear which solution is optimum under which conditions (Fig. 1). Objective criteria are needed for distinguishing which solution may best meet the multiple goals formulated under different circumstances.

In this presentation we will restrict ourselves to two of these multiple goals, **productivity** and **biodiversity conservation**, and we will not touch on the important aspects of equitable sharing of benefits among the population and the institutional mechanisms and bottlenecks in achieving these goals in the real world. We will focus the discussion on the humid tropics.

Productivity is here defined as the value of output minus production costs discounted over the complete lifetime of the production system, expressed per unit area. Where multiple products come from the same unit of land, they are added on the basis of their market value.

Biodiversity conservation is defined from a global perspective, which means that only conservation of viable populations of the native forest species contributes to the 'biodiversity value'. The appearance of cosmopolitan or ubiquitous species, linked to the clearing of large tracts of forest has no value in terms of global biodiversity conservation. The richness of