

Chapter 1

INTRODUCTION

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1. Research Objectives

The biodiversity of forest ecosystems is closely related to their ecological soundness, which refers to the ability of the ecosystem to provide us with various kinds of ecosystem services. The rapid decrease in the area occupied by forest ecosystems and the deterioration in their quality have been caused by social, economic, and ecological factors that vary among regions, and these factors are insufficiently well understood. The mechanisms responsible for biodiversity loss as a result of forest utilization are thus still unknown. Developing sustainable forest management systems thus requires an understanding of these mechanisms, which have become a priority for research.

As a practical way to increase the awareness of citizens of the importance of environmental sustainability, and particularly that of forests, quality labeling initiatives such as FSC (Forest Stewardship Council) are currently the subject of ongoing trials. Several movements to establish criteria and indices for “sustainability”, such as the Montreal and Helsinki processes, have been started as a result of international collaborations. Maintaining high biodiversity is one of the most important criteria, though it sometimes requires considerable study to establish appropriate indices.

In some parts of the Earth, traditional forest utilization systems have been considered to be sustainable, but these traditional systems are at risk of collapse due to the rapid recent changes in human lifestyles without waiting long enough for a scientific evaluation of the sustainability of these changes, particularly from the viewpoint of biodiversity. It is also urgent to find sustainable models for many regions that currently lack sustainable systems.

In the project described in this report, we are trying to evaluate the sustainability of various aspects of forest utilization in tropical and temperate regions in Asia, with a particular emphasis on biodiversity. The ecosystem services that are at risk of being lost as a result of decreasing biodiversity should be identified by this research. In addition, we are evaluating the socioeconomic and cultural aspects of each forest utilization system, including both traditional and modern management systems, in the study region. The driving forces and incentives behind recent changes in forest utilization systems are also being studied. Finally, we are trying to present new and comprehensive ways to assess these forest utilization systems.

To accomplish these goals, we have developed the following four research questions that will be answered for four selected temperate and tropical forest areas in Asia:

1. What are the historical changes that have occurred in forest utilization, and the social and economic backgrounds for these changes?
2. What are the impacts of forest utilization on biodiversity and ecosystem function?
3. What changes in ecosystem services have been caused by forest biodiversity changes?

4. Is it possible to develop an integrated evaluation system for evaluating the degrees of sustainable utilization of forest ecosystems and of biodiversity?

The following chapters describe our results in studying these questions. In Chapter 2, we discuss the changes in forest utilization in recent decades (the past 50 to 100 years) and the driving forces behind these changes. The effects of such changes on biodiversity and ecosystem function will be discussed in Chapter 3, and the effects on ecosystem services will be discussed in Chapter 4. Chapter 5 will discuss our analyses of existing systems of forest and biodiversity utilization. Finally, Chapter 6 will present an integrated assessment system for the degree of sustainable use of forest ecosystems and of biodiversity.

2. General Design of the Research

Research sites and target forest systems

Considering the biodiversity information that has already been obtained and forest utilization in the past and at present, we selected four sites with different forest types for our studies. These sites represent a range of types of forest utilization, including natural forests with the least extent of human impacts, man-made forests (plantations) developed for timber production, forests subject to so-called sustainable traditional forest use, and forests managed using modern forest utilization techniques. The four forests selected for our study are:

1. The Lambir Hills National Park, a tropical lowland rain forest (including forest reserves, forests used for ecotourism, forests used for commercial logging, forests managed by traditional and recent shifting cultivation, and oil palm plantations)
2. The Kinabaru National Park and the Deramakot Forest, which are tropical montane and lowland forests, respectively (including forest reserves, forests used for ecotourism, forests used for commercial logging, man-made forests, forest areas used for vegetable cultivation, and environmentally certified forests included in the Deramakot Forest).
3. The Yaku Island warm-temperate rain forest (including forest reserves, forest used for ecotourism, commons forest, and forest plantation)
4. The Abukuma Mountains temperate deciduous forest (including forest reserves, the satoyama system of traditional forest management, forests managed with natural regeneration practices, forest plantation, and pasture land)

Research subjects

The following subjects were studied in parallel at the four sites to permit a comparison and integration of the results:

1. Historical changes in forest utilization and their social and economic backgrounds
 - Historical changes in forest utilization: Forest utilization and its changes during the past 50 to 100 years were studied using land-use maps, aerial photographs, and satellite images. This data will be entered into a geographical information system (GIS) to permit comparative analyses among the sites.
 - Social and economic backgrounds: The incentives that motivated people or organizations to cause the observed changes in forest utilization were analyzed by means of sociological and economic analyses.

2. Evaluating the impacts of forest utilization on biodiversity

- Screening of target organisms: The target organisms were selected through screening tests based on their suitability as index species for detecting the impacts of forest utilization.
- Biodiversity assessment for the forest types: Using the screened organisms, the variations in flora and fauna among forest types were investigated quantitatively. Organisms were classified into functional groups such as trees and forest floor plants.
- The mechanisms responsible for biodiversity loss: The mechanisms through which forest changes lead to biodiversity losses were studied, in particular, we focused on the change of interactions between organisms.
- Biodiversity and ecosystem functions: The ecosystem functions, and particularly those that are closely related to the ecosystem's self-maintenance systems, should be carefully studied. This study includes intensive studies of gene flow using DNA markers.

3. Evaluation of ecosystem services provided by biodiversity

- Biodiversity and ecosystem services: The impacts of biodiversity loss on human life were studied. This analysis focused on the services provided by biodiversity, and particularly on the provision of non-timber forest products, regulatory services such as pollination and pest control, and cultural services such as educations and/or ecotourism.

4. Conditions necessary for sustainable forest management

- Biodiversity and sustainability of local communities: Institutions and economic incentives that serve to enable sustainable resource use and preserve local cultures were examined so as to develop effective methods and criteria for evaluating the sustainability of local communities.
- National or regional institutions that promote sustainable use of forest ecosystems and biodiversity were studied to identify their operating mechanisms and any problems that prevent these mechanisms from working properly.
- Policy and economics: Several political systems and economic models that have been applied to assess the sustainable use of forest ecosystems and biodiversity were analyzed and evaluated.

To effectively integrate the results, we created a matrix that combined the research sites with the research subjects. The biodiversity researchers focused more specifically on individual sites, whereas the sociologists and economists tried to work across sites.