# REFORESTATION OF DEGRADED TROPICAL FOREST LANDS IN THE ASIA-PACIFIC REGION

**David Lamb**

*Botany Department, University of Queensland, Brisbane Australia*

*Received January 1994*

**LAMB, D. 1994. Reforestation of degraded tropical forest lands in the Asia-Pacific region.** This paper reviews the reforestation of degraded tropical forest lands in the Asia Pacific region. The scale of the problem is defined and methods of dealing with such lands are considered. These methods may be classified as a three-point sequence of reclamation/rehabilitation/restoration on a continuum upwards from degradation. Choice of approach must be guided by the social and economic context, so that a variety of approaches will be needed in the region. This paper provides a background to the other papers in this special edition. These papers were presented at a workshop on the Rehabilitation of Degraded Tropical Forest Lands held at the University of Queensland, Australia in November 1991.

Key words: Reforestation - reclamation - rehabilitation - restoration - degraded lands - Asia-Pacific

**LAMB, D. 1994. Pemulihan tanah hutan tropika ternyahgred di rantau Asia -Pasifik.** Kertas kerja ini mengulas penghutanan semula tanah hutan tropika ternyahgred di rantau Asia Pasifik. Skala masalah ini dijelaskan dan kaedah untuk menangani masalah tersebut dipertimbangkan. Kaedah-kaedah ini boleh diklaskan sebagai urutan tiga penjuru yang merangkumi penebusgunaan/pemulihan/ pembaikpulihan. Pemilihan pendekatan mesti berpandukan kepada konteks sosial dan ekonomi, jadi pelbagai pendekatan akan diperlukan di rantau ini. Kertas kerja ini membekalkan latar belakang kepada kertas kerja-kertas kerja lain dalam edisi khas ini. Kertas kerja-kertas kerja ini telah dibentangkan di bengkel Pemulihan Tanah Hutan Tropika Ternyahgred yang telah diadakan di Universiti Queensland, Australia pada November 1991.

## Introduction

All tropical forests are naturally subject to disturbance and change. At the smallest scale this occurs when single trees die and fall over. At a larger scale it occurs when rivers change course or landslides occur or when volcanic eruptions spread pyroclastic material over large areas (Johns 1986). Such disturbances create a mosaic of different age classes in most forests and have been hypothesised to help maintain species diversity (Connell 1978).

Human activities add a new range of disturbances to these naturally occurring events. They can differ in intensity, frequency and scale. With the rise in human populations the nett effect has commonly been a gradual change in the disturbance regime leading to the degradation of some tropical forests. Degradation is a term keyed to human expectations (World Resources Institute 1988). Forest land cleared by a shifting cultivator would not be seen as degraded by the farmer but

might be regarded as such by a forester. The notion of degradation is, therefore, somewhat subjective. In the present context, however, degradation shall be taken to mean either formerly forested land from which the trees have been removed and which is being farmed in a way unlikely to be sustainable into the future; or forest land that has been severely disturbed in some way (e.g. by agriculture, mining or uncontrolled logging) and has since been abandoned. The land then has a reduced species diversity and productivity. In the particular case of logging, such forest is unable to provide further timber harvests in the foreseeable future.

## Scale of the problem

Although it is widely recognised that degradation is occurring and that biodiversity is being lost throughout the region it is very difficult to obtain any quantitative data that provide a regional perspective on the scale of the problem. Part of the reason for this is that different countries report the problem in different ways. Another is that the rate of change is extremely rapid, so that available statistics usually lag behind the field situation. Despite differences in terminology and lags in the availability of data some indication of the magnitude of the problem is given in Table 1 which shows one recent estimate of the rates of annual "deforestation" and "reforestation" in the region. In this case "deforestation" is not exactly equivalent to degradation as defined earlier but is used to describe the permanent clearing of forest for use in shifting agriculture, permanent agriculture or settlements. It does not include other alterations such as selective logging (unless the forest cover is reduced to less than 10% that can substantially affect forest habitats, soils and wildlife. "Reforestation" refers to the establishment of plantations for industrial and non industrial uses and does not include regeneration of old tree crops (e.g. through natural regeneration). The data show that recent rates of deforestation are mostly greater than those estimated for the early 1980s. They also show that the rates of reforestation are substantially less than the rates of deforestation.

**Table 1.** Rates of deforestation and reforestation in countries of Southeast Asia

| | Natural forest (000 ha) (1980) | Average annual deforestation 1981 - 85 (000 ha) | (%) | Most recent estimate (year) | (000 ha) | Average annual reforestation 1981 - 85 (000 ha) |
|---|---|---|---|---|---|---|
| Indonesia | 116 895 | 620 | 0.5 | 1982-90 | 1000 | 131 |
| Malaysia | 20 996 | 255 | 1.2 | 1979-89 | 270 | 20 |
| Thailand | 15 675 | 379 | 2.4 | 1985-88 | 235 | 24 |
| Vietnam | 10 110 | 65 | 0.6 | 1985 | 200 | 29 |
| Laos | 13 625 | 130 | 1.0 | | - | 1 |
| Cambodia | 12 648 | 30 | 0.2 | | - | 0 |
| Philippines | 9 510 | 92 | 1.0 | 1980-87 | 150 | 50 |
| Myanmar | 31 941 | 105 | 0.3 | 1984 | 600 | 0 |
| Papua New Guinea | 38 175 | 23 | 0.1 | | - | 2 |

Source: World Resources Institute (1992).

Some of this deforested land is used for productive agriculture but much is used temporarily and then abandoned and becomes forest "fallow" or secondary forest. Large areas of such secondary forest also originate after excessively intense logging or other disturbances such as the wildfires that burnt large areas of East Kalimantan in the early 1980s. One earlier estimate of the amounts of such regrowth forest or "fallow" is given in Table 2. This shows that the areas are very large and in some countries make up a high proportion of the total "forest" area.

**Table 2.** Forest "fallow" or secondary forest in countries of Southeast Asia

| Country | Area of forest fallow (000 ha) | Area as percentage of intact closed forest |
|---|---|---|
| Indonesia | 13 460 | 10 |
| Malaysia | 4 825 | 20 |
| Thailand | 800 | 10 |
| Vietnam | 107 000 | 120 |
| Laos | 5 000 | 60 |
| Cambodia | 200 | - |
| Philippines | 3 520 | 40 |
| Myanmar | 18 100 | 60 |
| Papua New Guinea | 1 380 | 4 |

## Methods of dealing with degraded lands

A common response to the problem of tropical forest degradation is to simply abandon the land. Such land may then begin to slowly recover its productivity and biological diversity if no further disturbances occur and if some of the original biota remain on or near the site. The time for this to occur will depend on the extent of degradation but is likely to easily exceed 100 years (Riswan *et al.* 1985, Lamb 1990). Alternatively disturbances may have pushed the system over an ecological threshold meaning that recovery is slow or impossible and that once abandoned, the site may remain as it is or even continue to degrade further. A common example of this is the large areas of *Imperata* grasslands that have replaced forests in many parts of the tropics. These are often induced by fires and, once established, are subject to recurrent fires that prevent successional processes developing that might allow reforestation to occur. But if abandoning degraded land was once an appropriate response it is clear that this is no longer the case in most countries. Rising populations mean that agricultural land is in increasingly short supply and it makes much more sense to improve the productivity of already cleared land than to continue to clear remaining forests. Not only do these remaining forests supply valuable goods and services (e.g. clean water) to downstream populations, reforesting the degraded lands can do likewise.

There are three broad approaches to overcoming degradation and hastening the recovery process. The first and most ambitious of these is **restoration**. Restoration means attempting to recreate the original forest ecosystem by reassembling the original complement of plants and animals that once occupied the site. The second approach is **rehabilitation** which means using some of the original species

plus, where necessary, exotic species to reforest the site. In this case there is no attempt to recreate the original ecosystem. Rather the objective is to return the forest to a stable and productive condition. This new forest does, however, include some of the original species. The final alternative is **reclamation**. This means using one or more exotic species to achieve stability and productivity. That is, there is no attempt to restore any of the original biodiversity at the site.

The three alternatives are illustrated in Figure 1. Reclamation is commonly carried out using species such as *Pinus*, *Acacia* or *Eucalyptus* and is the approach used in most traditional forest plantation schemes. Plantations of these species may have a greater biomass than the original ecosystem, especially if the sites are fertilised. In many cases such monocultures may develop diverse, species-rich understoreys of native species which colonise the site from nearly intact forest or forest remnants. In such cases what began as reclamation may change to fit the definition of rehabilitation. The extent to which this understorey develops to contribute to the forest canopy depends, of course, on the timing of any harvesting operations. In terms of species conservation rehabilitation has an advantage over reclamation in that local species are used. The significance of the advantage will depend, of course, on the extent to which these local species are also used in monocultures or whether more species-rich silvicultural systems are developed. In certain situations it may only be possible to grow local species if temporary or permanent mixtures are used.

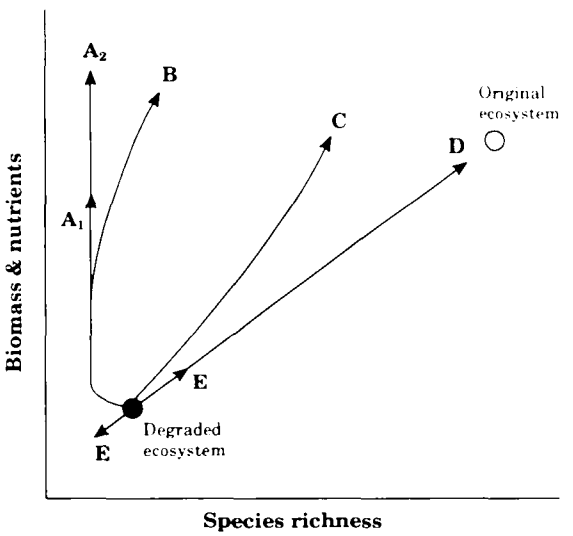


**Figure 1.** A simplistic depiction of ecosystem development using species and complexity to describe ecosystem structure plus biomass and nutrient content to describe ecosystem function. Reclamation involves plantation monoculture of exotic species (A) which may have a biomass less than (A1) or greater than (A2), the original biomass depending on the use of weedicides and fertilisers. These may acquire a diverse understorey over time (B). Rehabilitation involves both native and exotic species (C) while restoration (D) leads to a recreation of a new system approximating the original ecosystem (adapted from Bradshaw 1987). If the degraded system is neglected it may gradually recover or degrade further (E)

The reclamation/rehabilitation/restoration sequence are three points on a continuum upwards from degradation. Along the same continuum conditions progress from necessity to luxury, from less expensive to more expensive and from many examples to few. In most countries the pressures of population mean that the emphasis is at the lower end of the continuum. This is for two reasons. One is that the resources available are commonly less than in more developed regions. Another is that high population densities are likely to result in a demand for a system that rapidly provides some economic or other social return.

This simple three-way classification highlights alternative approaches to dealing with forest degradation. There are, however, a very diverse range of silvicultural techniques that might be used to achieve each of these end points. Several are shown in Table 3. In some cases a nurse crop can be used to ameliorate a site, perhaps by altering the light climate or by enriching soil organic matter or by fixing nitrogen (or by doing all of these things). Various plants might be established beneath this canopy including high value timber trees, various food plants or even species from the original flora if restoration is the objective. Alternatively, reforestation might be carried out without a nurse crop overstorey. In this case a monoculture of trees such as *Pinus, Acacia* or *Eucalyptus* might be used or an even-aged mixture of species might be established. Again, these might be timber trees, timber trees plus food plants or even a mixture of some of the species originally present at the site. There are many variations beyond these possibilities including the many different forms of the old taungya system that still have advantages in some locations.

**Table 3.** Silvicultural strategies for reforesting degraded forest lands in the humid tropics

| With nurse crop overstorey | | Without nurse crop overstorey | |
|---|---|---|---|
| Single species under planting | Mixed species under planting | Single species planting | Mixed species planting |
| Example: timber tree species prone to insect attack (e.g. *Meliaceae*) beneath a temporary cover crop | Example: many agroforestry systems in which timber trees have food crops planted beneath them | Example: timber species (e.g. *Pinus, Acacia, Eucalyptus*) | Example: agroforestry systems involving timber trees plus intermixed food trees |

## The social and economic context

The decision on what to do about degraded lands and which of these three approaches should be adopted is necessarily guided by the social and economic context of the situation. Where large areas of degraded land are available and rural populations are low then timber plantations or plantations of multipurpose trees might be feasible. Which species should be planted requires a very careful

## Acknowledgements

The workshop was sponsored and financially supported by the Institute for Tropical Rainforest Studies, UNESCO Regional Office for Science & Technology for Southeast Asia, Australian International Development Assistance Bureau, the International Union for the Conservation of Nature (IUCN) and the Australian National Commission for UNESCO. Field visits were arranged with the assistance of staff of the Queensland Forest Service and Consolidated Rutile. I am grateful to Peter Lawrence, Steven Howell, David Doley, David Yates and Mike Olsen for the very considerable assistance they provided in organising and running the workshop. I am indebted to Moya Tomlinson for her help in editing the various contributors' papers published in this issue of the Journal of Tropical Forest Science.

## References

CONNELL, J. 1978. Diversity in tropical rainforests and coral reefs. *Science* 199 : 1302 - 1310.

FAO/UNEP. 1981. *Tropical Forest Resources Assessment Project.* Rome.

GILMOUR, D. & FISHER, R. 1991. *Villagers, Forests & Foresters: The Philosophy, Process and Practice of Community Forestry in Nepal.* Sahayogi Press, Kathmandu.

JOHNS, R. 1986. The instability of the tropical ecosystem in New Guinea. *Blumea* 31: 341- 371.

LAMB, D. 1980. *Exploiting the Tropical Rainforest.* UNESCO & Parthenon Publishing Group, Carnforth.

LAMB, D. & TOMLINSON, M. 1994. Forest rehabilitation in the Asia-Pacific region: past lessons and present uncertainties. *Journal of Tropical Science* 7(1): 157-170.

RISWAN, S., KENWORTHY, J. & KARTAWINATA, K. 1985. The estimation of temporal processes in tropical rainforest: a study of primary mixed forest in Indonesia. *Journal of Tropical Ecology* 1: 171 - 182.

WORLD RESOURCES INSTITUTE. 1988. *World Resources 1988-89.* Basic Books Inc, New York.

WORLD RESOURCES INSTITUTE. 1992. *World Resources 1992-93.* Basic Books Inc. New York.