# The Ecologist

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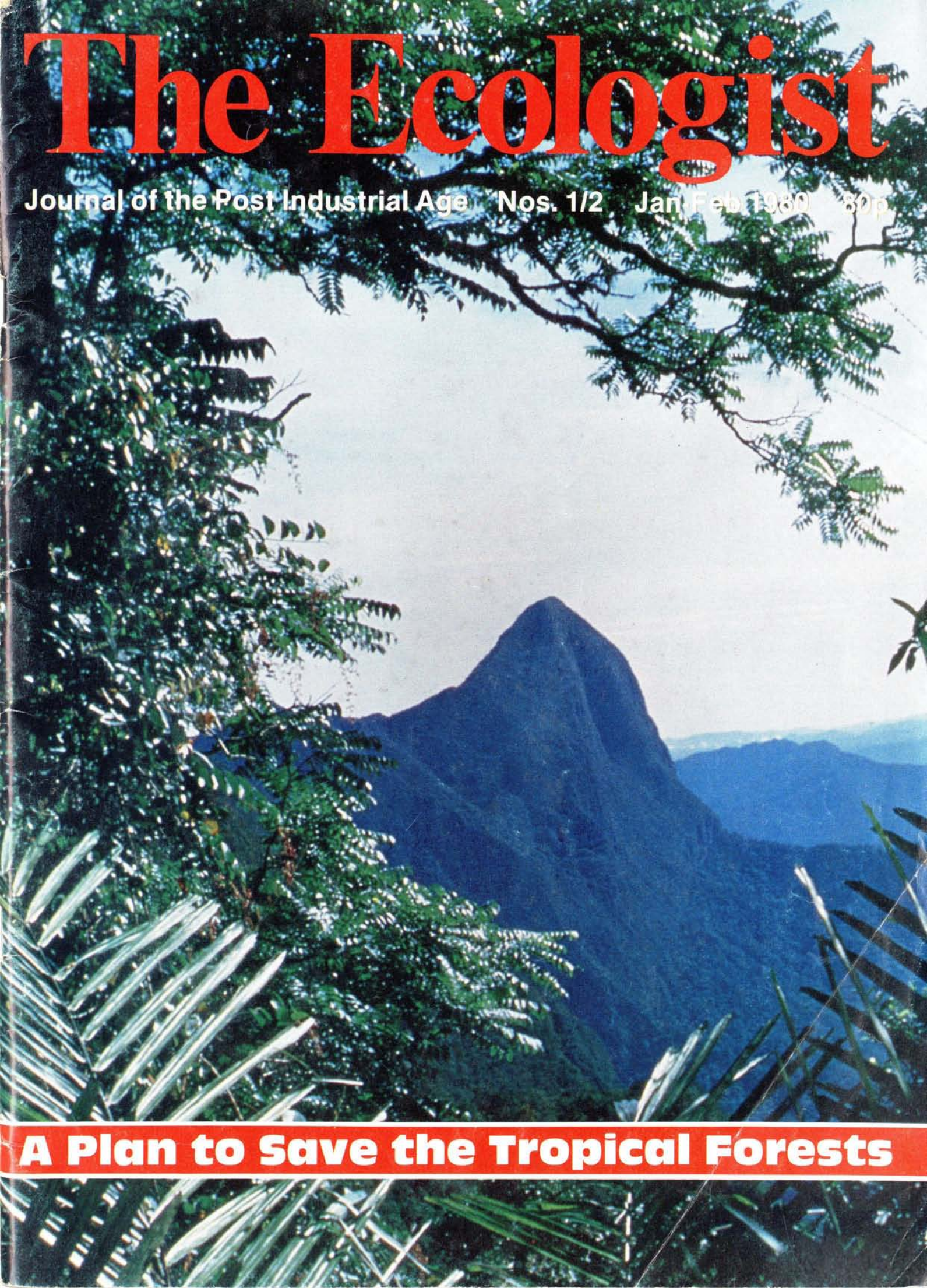

## A Plan to Save the Tropical Forests

# W.E.A.P.

## STATEMENT OF SUPPORT

The undersigned, without endorsing every detail, fully support the basic principles embodied in the WEAP proposal, both in respect of the analysis of the problems and the solutions proposed. This endorsement is however personal and does not necessarily reflect the views of the institutions with which the signatories are involved.

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# The Ecologist

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## The Problem

**This proposal has been drawn up after a long correspondence with a number of eminent ecologists and conservationists, most of whom have signed the statement of support. I am greatly indebted to them for their invaluable help.**

1. The world's remaining tropical forests are being destroyed so fast that, at current trends, by the end of this century, only the most inaccessible will remain. This terrible tragedy will mean:

   - the destruction of the way of life of the indigenous peoples who inhabit these areas which must lead to their systematic pauperisation i.e. to their transformation into a marginal, largely unemployed proletariat leading a miserable and precarious existence in the shanty towns surrounding already drastically overcrowded cities:

   - the disappearance of a considerable proportion of the world's trees and plant species, many of which have not even been identified:

   - the disappearance in the wild of much of the world's remaining wildlife, including large cats such as the tiger and Clouded leopard and primates such as the gorilla and orang utan:

   - the loss of an inestimable reservoir of genetic resources that could be exploited to provide new foods, medicines, textiles, etc., and raw materials including bases for fuels which could be of vital importance in a largely unforeseeable future:

   - soil erosion by wind and water — as most tropical soils have a low organic content and may become little more than dust, while others become brick-like laterite once they are deprived of their tree cover — in many cases leading to eventual desertification:

   - massively increased run-off to rivers and, in particular, when their beds have been raised following erosion from the mountains above, to floods in the surrounding plains — since only a fraction of the rainwater that can be stored around the root system of a tropical forest can be retained in the eroded soils of bare mountainsides:

   - reduced transpiration and hence precipitation, with a further reduction in water availability:

   - increase in the $CO_2$ released into the atmosphere but reduced absorption of $CO_2$ by depleted plant life with climatic consequences that are likely to be detrimental to world food production:

   - the loss of the soil's capacity to provide timber and other benefits on a more realistic but sustainable basis:

   - an aesthetic and scientific loss of unparalleled dimensions.

2. What, we might ask, will the countries who are cutting down their forests obtain in exchange? The answer is foreign currency largely to pay for imported consumer products that only a minority can afford and raw materials required for industrial development, which occurring as it must, in decreasingly propitious conditions, seem doomed to be short-lived.


# World Ecological Areas Programme

## A Proposal to save the World's Tropical Rain Forests.

How can this fatal trend be reversed? We are sure that many plans are at present being considered. One was worked out at *The Ecologist* in 1971 and presented to a meeting of the Non-Government Organisations at the United Nations Conference on the Environment in Stockholm in 1972. We referred to it as the World Ecological Areas Programme (WEAP). For the past year, a group of leading conservationists and ecologists, in different parts of the world, have considered various strategies and have concluded that a programme solely designed to preserve world tropical forests would be unlikely to succeed in as much as it would ignore current short-term economic and political problems and give no incentive to the appropriate decision makers to reverse their present policies. The World Ecological Areas Programme has therefore been revised to take account of short-term realities while keeping long-term objectives in view. This we are confident will enable action to be taken in the short time-scale which is crucial to the survival of forest ecosystems on which the world depends.

### The Plan

Such incentives, it is suggested, could be available if the preservation of tropical forests were seen as part of a wider development project. Within the framework of such a project, the forests could provide collateral for loans to be advanced by international agencies involved in development, for activities that are desirable *directly* for the economic and other benefits that they might confer to the inhabitants of the areas in which they are set up, and *indirectly* in that they are precisely those that could best reduce the present pressures on tropical rain forests.

Alternatively the natural forests would be rented outright by local bodies set up and financed by international agencies with the proviso that the rental be invested in such desirable economic activities.

In the future, the scheme could be expanded so that countries which do not have tropical rain forests to protect, could provide instead as collateral for loans, other valuable biological resources (wetlands or estuaries, for instance). This could be seen as part of a wider plan to prevent the further destruction of the life support systems of our already seriously degraded planet.

The value of the forests and other biospheric resources held as collateral could be calculated very generously so as to take into account all the biospheric, social and in the long run, economic advantages that they must provide, not merely their value in terms of the timber which can be extracted from them.

One of the virtues of WEAP is that it cannot be regarded as a conspiracy to impede 'development' (as many conservation projects are seen to be) but as providing, on the contrary, a means of obtaining the much needed finance for valuable development programmes. Let us now consider what such programmes might be.

### Components

**1. An increase in the rate and scale of commercial afforestation in tropical areas**

The pressures on the remaining tropical forests could be reduced if the attention of timber companies could be diverted to large-scale and economically viable afforestation programmes. Both the World Bank and the Asian Development Bank have called for massive afforestation in the next two decades, not only to maintain the supply of timber to developed countries but to satisfy a rapidly expanding demand in developing countries that at the moment consume relatively little processed wood but desperately depend upon wood as their main energy source. Any strategy has got to take into account both the need to maintain, if not expand, wood production and to substitute other

sources of income, if current exploitation of natural forests is to be severely curtailed in the short-term.

Some way must be found to make the establishment of sound forestry practices financially worthwhile. One approach might be to take large areas of forest out of exploitative use as is happening in Sabah. This would make it possible to obtain higher prices for timber still being extracted and make investing in plantations even more attractive.

In addition fiscal advantages for afforestation could be provided at a local and a national level.

It seems that the profitability, though relatively low, of commercial forestry, is quite respectable by agricultural standards. If afforestation is not always economically attractive, it is largely because the enterprises involved must wait so long before realising this profit. It would clearly be advantageous if means were set up to provide them with annual payments on a scale that would compare favourably with those obtained from logging natural forests and also from agriculture. Governments could arrange for this if they themselves were provided with the appropriate inducements.

This condition would be satisfied if Governments were granted loans on the collateral of their natural forests, and concessions that have already been granted were then suspended. In such conditions, holders of such concessions would obtain instead an equivalent area of already deforested land on which they would be invited to establish plantations. Governments could set up, among other things, National Forestry Banks, which would seek to obtain finance for afforestation schemes from corporations and from the general public. This would probably mean issuing shares or bonds providing the purchasers with a financial stake in the rapidly appreciating assets represented by plantations of commercially desirable trees. The Banks would help assure the ready negotiability of such shares and bonds which would appear to be necessary if they are to provide an attractive investment.

**2. The Setting up of local wood processing enterprises**

At the moment a high proportion of tropical hardwood is exported as logs and processed by countries such as Japan, South Korea, Taiwan and Singapore before reaching consumers in Europe and America. This has two consequences; first, revenue earned by country of origin per cubic metre of wood exported is relatively low because of the relatively low value added by processing. Second, it is not unusual for countries to have to spend about half their export income on importing processed forest products such as paper from developed countries. So not only are they not provided with an adequate incentive to restore their exploited forests but a large proportion of the money which they do receive goes straight back to the rich countries to pay for processing of a raw material which they possess in plenty. It is thus very much in the interests of wood exporting countries to set up their own wood processing plants.

Paradoxically, this could also lead to reduced pressures on the remaining tropical forests, as by exporting high value finished products, fewer trees would be required to achieve a given export income, and also because local companies would be more concerned to preserve their resource-base than multinationals that simply extract what can be extracted and then move on elsewhere.

To render local wood processing plants more attractive would be much easier. To achieve it would not necessitate, for instance, the setting up of any specialised institutions. To begin with such enterprises could be made to benefit from various fiscal advantages at a local and at a national level — just as would afforestation schemes.

Also, in order both to help them and to assure that their impact on natural forests would not simply supplement that exerted by existing lumber companies, the export of logs could be limited by law as is the case in a growing number of tropical countries.

Industrial nations would be required to reconsider current tariffs which discriminate against imports of wood processed in the countries of origin against those obtained from the major processing centres.

Hopefully industrial nations will see it in their long term interests to maintain the stability of wood production in the tropics upon which they still depend for much of their supplies and actively co-operate with this scheme.

It must be noted that such a policy would be in keeping with the spirit of the 'New Economic Order' (which industrial countries are at least morally bound to abide by).

**3. An increase in the rate and scale of commercial afforestation in the temperate industrial countries**

This will also reduce the pressure on tropical rain forests especially if hardwoods, such as oak and beech, are also grown, since their decreasing share of temperate forest production has been a prime cause of the exploitation of tropical hardwoods. The methods for stimulating afforestation in the tropics that have been suggested above should be even more applicable to temperate areas where greater political stability better favours investment from abroad.

**4. A shift from destructive to sustainable agricultural systems**

So far we have only considered strategies for reducing the damage done to tropical forests by commercial logging. WEAP could, however, if

necessary, be extended so as to help reduce the destruction caused by encroaching cultivators. According to the World Bank and others, this is one of the main causes of deforestation, for the cultivators are constantly clearing new areas of forest to replace the cultivated areas that have been degraded by unsound agricultural practices. The most sensible way to reduce this pressure is to seek to establish agricultural systems that are sustainable even on poor and often lateritic soils. Far more research and practical testing is required in this field.

The most promising systems are likely to consist of multi-layer and multi-species cropping, known collectively as agroforestry, which imitate the structure and nutrient cycling of the natural forests in order to avoid rapidly declining fertility and yields. Both wood and food may be grown in the afforestation schemes and forestry should be seen as having a vital role to play in the support of agriculture as has been demonstrated in China. Governments could obtain loans for setting up research institutions and educating peasant farmers in this sort of husbandry.

Apart from reducing pressures on what would appear to be otherwise condemned tropical forests, these enterprises would undoubtedly make a significant contribution towards the solution of three of the most intractable problems facing Third World countries today:

i) **Improve rural employment**

Afforestation can provide a lot of jobs. Local people would be involved and be responsible for the conservation of forests in their area as well as being employed in the planting and tending of the plantations and in the local processing plants.

ii) **Improve food self-sufficiency**

As development occurs people are deprived of the great variety of food to be found in the forest and in rivers which become polluted, and are forced to buy their food on the open market. In the great majority of cases they cannot afford to obtain in this way food of equivalent quality and diversity. The scheme would encourage the development of sustainable agricultural systems while at the same time preventing a reduction in yields due to soil erosion, flooding, etc.

iii) **Building a sound secondary industrial sector**

Both afforestation and wood processing would provide a sound and sustainable base for a thriving secondary sector that would make the most of local resources rather than exporting them in their raw state. As a great proportion of this could be located in rural areas, it would serve to reduce growing urbanisation.

The WEAP Secretariat, possibly attached to an existing organisation, such as IUCN, would initially establish a feasibility study for the larger scheme. Thereafter it would act in a consulting capacity to governments and financial institutes involved, suggesting suitable areas for conservation as collateral, monitoring the success of the schemes and recommending adaptations and follow-up programmes where necessary.

If WEAP is to be a practical proposition, it seems important that a meeting be arranged with those who may have worked out other serious plans for saving the world's remaining tropical forests — in order to determine how all such plans could complement or indeed mutually reinforce each other.

However, before a feasibility study be undertaken we should like to have:

- your ideas for improving this proposal
- information relevant to determining its feasibility
- suggestions as to how it might be financed.

Edward Goldsmith

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## Some Comments

*"Tropical forests, our greatest global genetic reserve and wildlife habitat, deserve immediate and serious attention from the international environmental community. I strongly endorse the efforts of* The Ecologist *to focus global interest on the problem. WEAP will provide a provocative and needed stimulus to all of us who care about the rational use of our all-too-finite resources and the protection of that most central element in the earth's eco-system, the tropical moist forests."*

*David R.Brower,* Chairperson, Friends of the Earth
San Francisco, California.

*"If and when some future Gibbon comes to write The Decline and Fall of Industrial Man, I suspect that one of the fundamental causes of our failure will be held to lie in the foolish belief that the world exists for man's exploitation. The tropical forests represent some of the most important natural features of our planet which still remain, and their rapid destruction by man for short-term ends represents one of the many blatant ways in which we seem determined to demonstrate our unfitness as a species."*

*D.Bryce-Smith, Ph.D., D.Sc., C.Chem., F.R.I.C.*
Professor of Organic Chemistry,
University of Reading.

*"The destruction of the world's tropical forests which is now proceeding at a frightening rate is one of the most clear-cut conservation issues. This destruction, in the great majority of cases, is entirely concerned with short-term gains and takes no thought for the future. The forests represent a unique resource which could be managed for the long-term benefit of all. Their management will require restraint and a proper under-*

*standing of how fragile and diverse tropical forests can be. Once destroyed they can never be restored and we shall have lost forever an environment of unparalleled beauty, diversity and richness and left in its place an effective desert.*

*Professor Aubrey Manning, D.Phil., F.R.S.E.*
Professor of Natural History,
University of Edinburgh.

# Letters

From *Hermana Mishra*, Ecologist,
His Majesty's Government of Nepal
National Parks & Wildlife Conservation Office

*Dear Sirs,*

*I have read the proposal as it now stands and am certainly willing to endorse it and you can count me among its signatories. I believe it is time that both bilateral and multilateral International Agencies, including the World Bank and the ADB are infused with such new ideas. Instead of the short-term objectives of "increasing exports" increase in foreign exchange reserves and other so called measures of economic development. Furthermore as an "ecocrat" in one of the least developed of the developing countries I cannot see how the ideas of WEAP can be regarded as a conspiracy to impede development, as many conservation projects are seen to be. However from my experience in Nepal, I have my reservations if international agencies like the World Bank and ACD can be induced to such an idea. In our experience in Nepal I have come across many instances often within the same period and certainly within the same governmental organisation when one ADB or World Bank "Mission" is discussing reforestation while others of "different-mission" of the same organisation are negotiating on clearfelling of large tracts of sub-tropical forests in southern Nepal, whereas they could easily provide assistance and loans not to destroy (the 2nd part) what is presently left and concentrate on reforestation and afforestation with a view to provide employment, fuel, fodder, building materials and the needs of the common people.*

*In specific reference to the questions at the end of your proposal, I have the following comments which perhaps you also could try to discuss and resolve in the Gabon meeting.*

*The first and foremost thing the World Bank, ACD, FAO and other bilateral and multilateral agencies could do is to establish a moratorium for at least the next decade in providing any kind of assistance that involves clearfelling, deforestation, etc., even if the idea is to "replace some slowgrowing native species with exotic fast growers" or to resettle the so called "Landless".*

*Perhaps WEAP could also initiate this programme by firstly taking countries like Nepal where conservation is not a question of "Luxury" or show the tourist a few rhinos or Mount Everest but a basic necessity for survival. in view of excessive erosion and deforestation. Nepal also seems to be one of the few countries in the World which seems to be "flooded" with promises and aid for assistance in trying to save the Himalayas from being drained into the Bay of Bengal but with no effective results since there seems to be little co-ordination between international agencies that is good for Nepal and HMG Nepal's immediate needs for cash and kind to provide food, education and shelter to the people of the country.*

*Thus I believe that WEAP scheme could bridge this gap.*

*I hope these comments will be of use to you,*

*Yours faithfully,*
*Hementa R. Mishra,*
*Katmandu, Nepal.*

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From *Professor George Wald*,
Nobel Prize Laureate in Biology.

*Dear Sirs,*

*Few persons — even few biologists — realise how tender and vulnerable are the conditions for life on this planet. The common view is that the physical environment is fixed and permanent and has been so back to long before life appeared upon the Earth. Also that it fixed the stage upon which life enacts the parts the environment permits: that the environment plays the tune to which living things must dance — or die. In reality, major aspects of our physical environment are the work of living organisms. There was no oxygen in our atmosphere until the planets put it there through the process of photosynthesis: and that is all that keeps the oxygen in the atmosphere now. It is estimated that all the oxygen at present in the atmosphere goes into cellular respiration and comes out of plant photosynthesis and so is completely renewed every 2,000 years — hardly a moment in geological time.*

*That constant provision of oxygen upon which all multicellular life depends is now threatened from two major directions. Most Photosynthesis on the Earth occurs, not in land plants, but in the algae living in the surface layers of the seas. A decade ago the petroleum residues floating in those surface layers of the Atlantic Ocean had already exceeded in bulk the algae, with long-term consequences that none of us can predict. The other major threat is the progressive denudation and consequent desertification of the Earth owing to widespread destruction of the world's forests.*

*For a long time now, human kind has been the dominant species. We must stop seeing that only as our power to despoil the Earth. It means rather our responsibility to take care of it: to take care of the Earth, of life on the Earth and of human life.*

*Yours faithfully,*
*George Wald,*
*The Biological Laboratories,*
*Harvard University,*
*Cambridge, Mass.*

From *R.H. Kemp*, Forestry Adviser,
overseas Development Administration,
London.

*Dear Sirs,*

*The subject you raise is a most important one and I am personally very pleased to see the positive attitude shown by the outline plan given in your letter. There can be no doubt that effective action to protect the remaining areas of natural forest is very largely dependent on 'the intensified use of the land allocated for food production as for wood production, under an integrated land use policy and plans' and 'the establishment of fast growing plantations for wood production on part of the very large area of degraded and presently unproductive land in the tropics . . .'. Here I am quoting from a paper I wrote with others in 1975 and I enclose a copy since you may be interested to see how closely some of the priorities we set then accord with some of the components of your plan.*

*Having read the attachment to your letter I am in full agreement with the objectives as set out in the four major components of your plan. You will appreciate that in saying this I am speaking as a scientist concerned over the destruction of tropical forests, and not as a spokesman on behalf of the Administration. As you know, our aid is given almost entirely in response to requests from overseas governments and is therefore dependent on the priority which they accord to the various sectors of development action. Nevertheless, in the field of forestry research, in which we attempt to solve common problems of importance to a number of countries, we have given a high priority to research to assist in the productive afforestation of deforested and degraded land in the tropics.*

*I hope that the restatement of the problem in your January issue will help stimulate such interest both locally and internationally and thereby improve the possibilities for positive action.*

*Yours faithfully.*
*R.H. Kemp,*
*London, S.W.1.*

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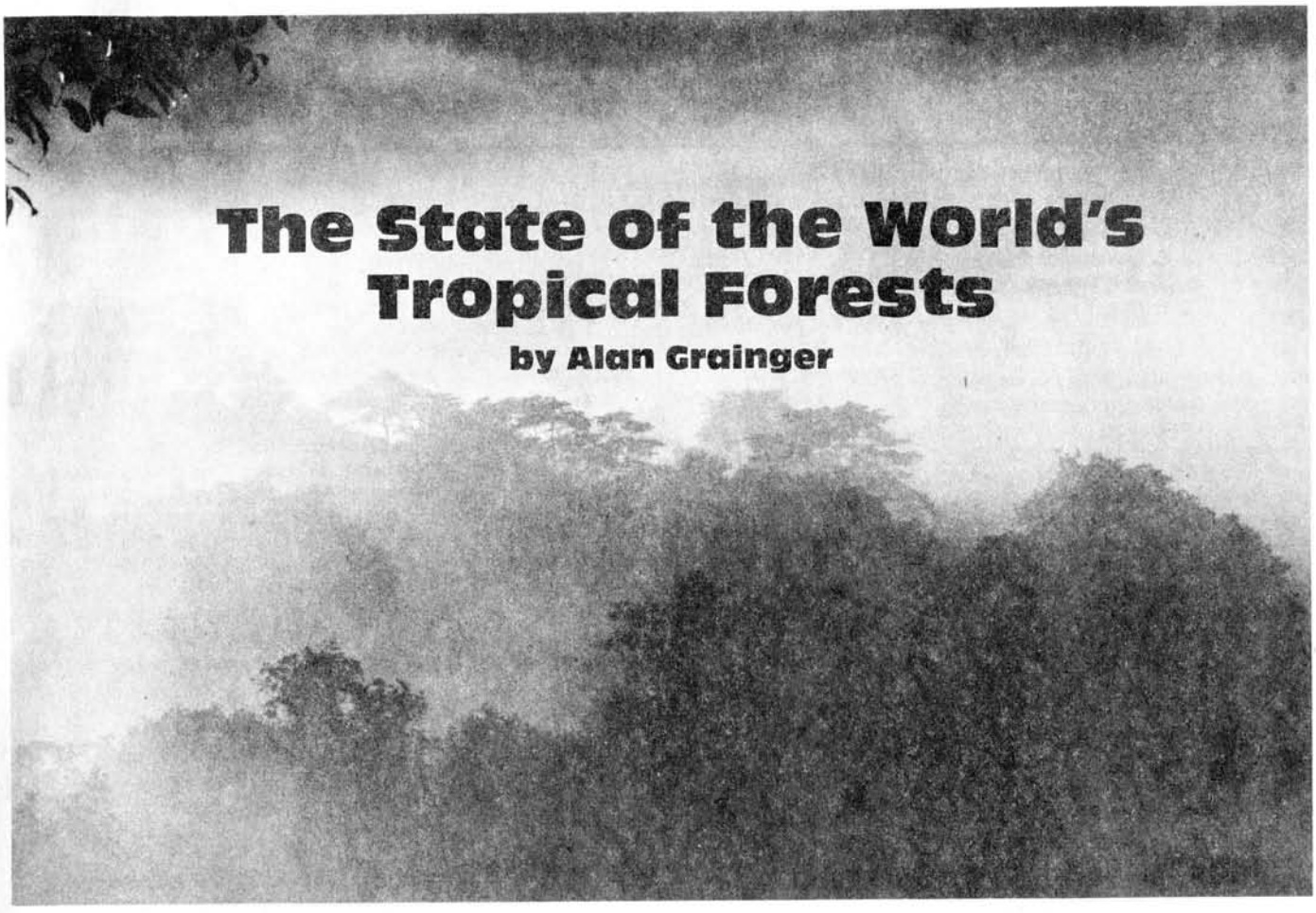
**W.E.A.P.**



R. Hanbury-Tenison

# The State of the World's Tropical Forests

**by Alan Grainger**

The world's tropical rain forests lie in a belt centred on the equator and extending 23½° north and south to the Tropics of Cancer and Capricorn. They form the major part of the area of tropical moist forests whose size in 1976 was estimated at 935 million hectares — equivalent in size to the U.S.A. This is 71 per cent of the total area of closed tropical forest and almost 30 per cent of all the forests in the world.

Adrian Sommer's 1976 estimates[1] (see Table 1) show that the largest area is in South America, covering some 472 million hectares in a region centred on the adjoining basins of the rivers Amazon and Orinoco. This does not include an extension of 34 million hectares along the Central American isthmus.

The majority of Asia's moist forests lie in South East Asia, but the area of 187 million hectares is only half that of South America. The bulk of the African rain forest of 175 million hectares is in Central Africa, centred on the Congo Basin, with extensions along the Guinea coast of West Africa to Sierra Leone. (Fig. 1)

**Two Types of Moist Forest**

Tropical moist forests comprise two general types — tropical rain forest and tropical moist deciduous forest. Moving away from the Equator and towards the Tropics the rainfall becomes more seasonal and the evergreen forests — previously referred to as equatorial rain forests — become more deciduous in character to avoid being dehydrated in the hot dry periods.

The tropical rain forests, famous for ebony and mahogany, have by far the more valuable flora and fauna. Tropical moist deciduous forests, for example the monsoon forests of Asia of which the characteristic wood is teak, have suffered much more from clearance at the hands of man.

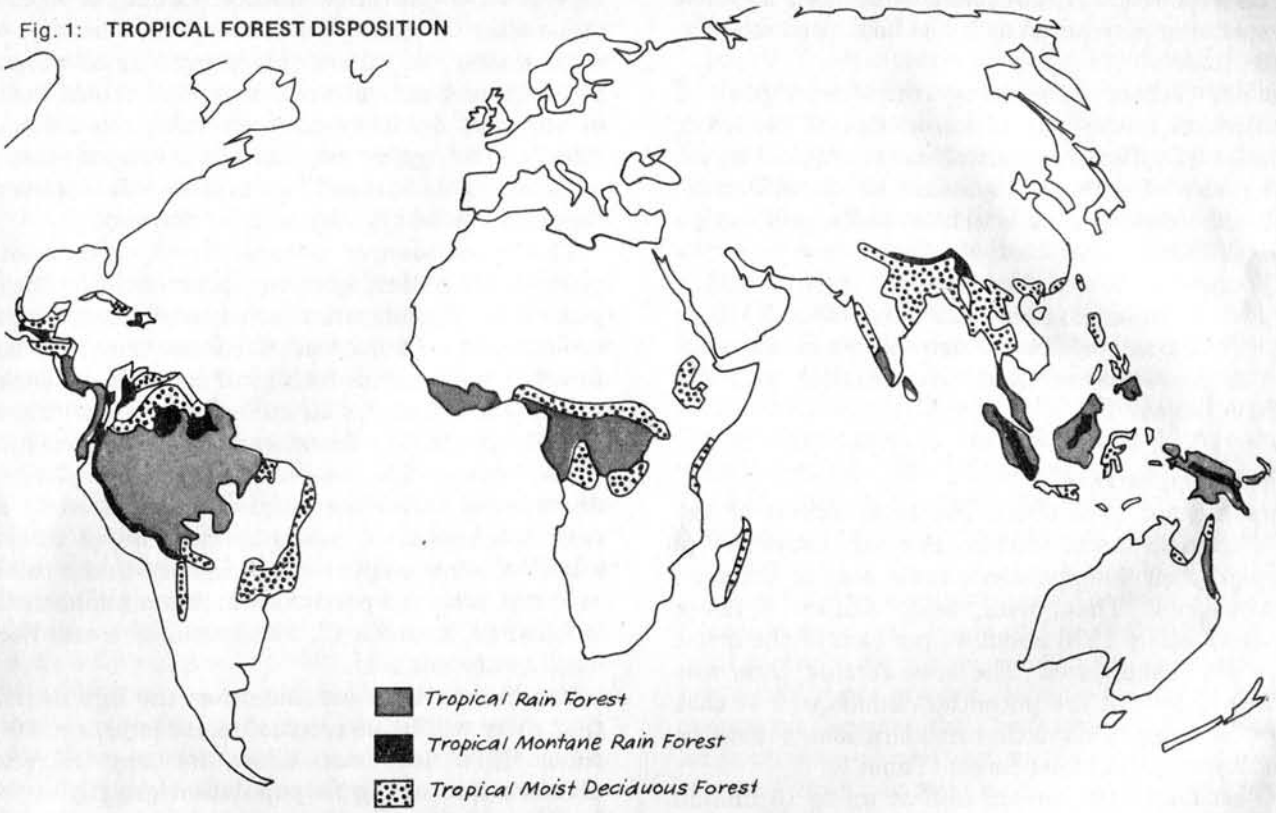
The latest estimates of global forest resources were made by Reider Persson in 1973.[2] While the total area of tropical moist forests differs slightly from Sommer's figure, Persson gives separate assessments which show that the tropical rain forests cover an area twice that of the tropical moist deciduous forests, approximately 568 million hectares. This is three quarters the size of Australia. (Table 2).

**Lack of Knowledge**

It is important to make the point that our knowledge of the world's forest resources is abysmal, and these figures are only approximations although calculated by experienced foresters with the full resources of FAO at their command. Delegates to the Eighth World Forestry Congress (Jakarta 1978) were so disturbed at our lack of knowledge of the world forest area that they asked FAO to prepare an accurate report for the next Congress in six year's time.[3]

FAO relies largely for its statistics on those supplied by individual governments. That such figures may be wildly inaccurate is shown by the recent example of the Philippines, which claimed that forests covered 57 per cent of its land area until satellite pictures from N.A.S.A. gave the true figure as 38 per cent. Priority should be given to obtaining remote sensing data from LANDSAT satellites but their use may be prevented by heavy cloud cover which is

Fig. 1: **TROPICAL FOREST DISPOSITION**




Source: Poore & Allaby (IUCN)

Table 1 **REGRESSION OF TROPICAL MOIST FORESTS**

| SUBCONTINENT | Moist forest climax area | Moist forest actual area | Regression as Regression | percentage of climax area |
|---|---|---|---|---|
| | ..... million hectares ..... | | | |
| East Africa | 25 | 7 | 18 | 72.0 |
| Central Africa | 269 | 149 | 120 | 44.6 |
| West Africa | 68 | 19 | 49 | 72.0 |
| TOTAL AFRICA | 362 | 175 | 187 | 51.6 |
| South America | 750 | 472 | 278 | 37.1 |
| Central America | 53 | 34 | 19 | 35.8 |
| TOTAL LATIN AMERICA | 803 | 506 | 297 | 37.0 |
| Pacific Region | 48 | 36 | 12 | 25.0 |
| South East Asia | 302 | 187 | 115 | 38.1 |
| South Asia | 85 | 31 | 54 | 63.5 |
| TOTAL ASIA | 435 | 254 | 181 | 41.6 |
| TOTAL WORLD | 1600 | 935 | 665 | 41.6 |

*Source: Sommer 1976*

Table 2 **WORLD FOREST RESOURCES 1973**

| | AREA million hectares | MEAN VOLUME cubic metres per hectare | TOTAL VOLUME billion cubic metres |
|---|---|---|---|
| 1. TROPICAL | 1456 | | |
| (i) Wet evergreen | 560 | 350 | 196 |
| (ii) Moist deciduous | 308 | 160 | 49 |
| (iii) Dry deciduous | 588 | 50 | 29 |
| 2. SUBTROPICAL | 224 | | |
| (iv) Wet evergreen | 8 | 80 | 0.6 |
| (v) Subtropical moist | 20 | 200 | 4 |
| (vi) Subtropical dry | 196 | 50 | 10 |
| 3. TEMPERATE | 448 | | |
| (vii) Broadleaved forest Coniferous forest | 448 | 150 | 67 |
| 4. BOREAL | 672 | | |
| (viii) Boreal forest | 672 | 60 | 40 |
| TOTAL WORLD | 2800 | 157 | 40 |

*Source: Reider Persson*

common over tropical rain forests and then airborne radar scanning is required as it has been used over the Amazon forest.[4]

Another factor hindering our attempts at quantification is the lack of knowledge of the exact boundaries of different types of moist tropical forest and the use of different systems of classification. Despite the valuable work which led to the publication by UNESCO in 1969 of *A Framework for the Classification of World Vegetation*,[5] there is still a great deal of confusion, as admitted by UNESCO in its recent (1978) *State of Knowledge Report on Tropical Forest Ecosystems* referred to hereafter as "the UNESCO Report".[6]

**Rate of Disappearance**

If we are not sure about the total extent of the world's tropical moist forests then any estimates of the rate of their disappearance must also be taken as approximations. That being said, Adrian Sommer estimates that by 1976 about 40 per cent of the moist forests had disappeared. The area at that time was only 60 per cent of the potential climax area — that which according to climatic considerations *should* be covered by tropical moist forest (Table 1).

FAO estimates the *annual* loss at up to 15 million hectares — slightly more than the area of England and Wales combined. Of this, 2 million hectares disappear every year in Africa, 5 million in Asia, and between 5 and 10 million in Latin America. West Africa and South Asia have lost most of their moist forests, with a regression of 72 per cent and 63.5 per cent respectively, and this is reflected in the lower rate of deforestation for Africa.[7]

The Eighth World Forestry Congress stated that: "On present knowledge the tropical moist forests are being destroyed at a rate of about 30 hectares a minute (and) the rate of destruction is accelerating. If it continues, these forests may cease to exist as usable forests in 40 to 50 years." On those figures we lose an area of tropical moist forest the size of a football pitch almost every second![3]

**Types of Deforestation**

The FAO figures only refer to the loss of closed forest to more open woodland, sites of permanent or short rotation agriculture, or pasture. This physical *degradation* of the forest must be distinguished from the *depletion* which occurs when the forest is selectively logged for its most valuable timber trees. Degradation very often ensures that we have lost that forest for all time, but if regrowth occurs, it is in the form of secondary forest which is of a much lower value and will persist for a long period.

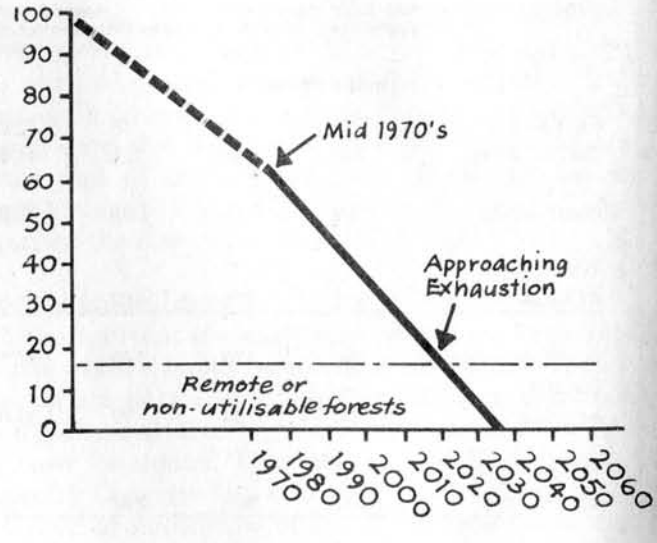
Depletion implies at the very least some modification of the forest ecosystem. The flora and fauna are highly interdependent, and should a particular tree be felled, an animal may lose not only its home but its place in the forest ecosystem whose overall functioning is thereby affected. The over-hunting of game is therefore a type of deforestation.

Depletion may also affect the wood producing capacity of the forest, despite the belief that regeneration will allow another culling of equivalent value after 35 years. For this reason, statistics which reassure us that we are only using a small proportion of the forests' annual wood increment should be looked at very closely. They may not take into account the effect which logging may have on the forest ecosystem, and assume instead a machine-like automatic regeneration which may well not happen.

The conversion of natural forest to monoculture plantations of fast growing commercial species like pines is a transformation of the ecosystem.[8] As far as ecologists are concerned it means that the natural forest is lost and its biological content and functions severely affected. As far as foresters are concerned, it is still a productive forest and included in the national forest estate. The use of the terms depletion and degradation is therefore subjective, and the conversion may not appear in statistics as 'loss of forest'. In addition, some countries may include in the total area of forest reserves portions which are euphemistically labelled as 'unstocked', i.e. devoid of trees. For how long we are not told.

If present trends continue then the figures indicate that there will be no tropical moist forests in 60 years time. This does not allow for any increase in deforestation owing to population growth or for the fraction of the total area which cannot be cleared because it is physically inaccessible or forms part of a protected National Park. (Fig. 2)

Fig. 2: **THE END OF THE TROPICAL RAIN FORESTS IS IN SIGHT**




# Regional Survey

**South East Asia**

South East Asia's rain forests are dominated by those found in the Malesian archipelago which are the richest in the world. Malesia is a term used by

botanists for the floristic region shown in Figure 3. Rain forest only extends into Thailand in the wetter regions, and going north from the Malaysian border the forests become increasingly seasonal with an intermediate zone of semi-evergreen forest. The northern boundary of the Malesian rain forest is determined by the northern limit of rain forest species and the southern limit of moist deciduous species.[9] (Fig 3)

About two thirds of Thailand's forests are located in the northern and north-eastern regions but they have suffered severe depredations owing to slash and burn cultivation. Most of the forests are in the hills, and thus serve a vital function of protecting the watersheds of major rivers like the Mekong and Phraya. Soil erosion and flooding is now endemic.[10]

The South East Asian logging boom began in the rain forests of the Philippines in the 1950s, spreading to Malaysia in the 1960s. The Philippines major timber producing region is the large southern island of Mindanao, which accounted for 78 per cent of total production by volume in 1972. Also important is the island of Luzon — on which the capital Manila is situated — with 15 per cent of production volume.[11]

A few years ago deforestation in the Philippines had become so serious that President Marcos made it a legal requirement for every male over the age of ten to plant one tree per month for the next five years. Forest cover is now only 38 per cent of the national land area, hill forests have been drastically reduced, and it seems that the forests are almost logged out of their more valuable species.[12]

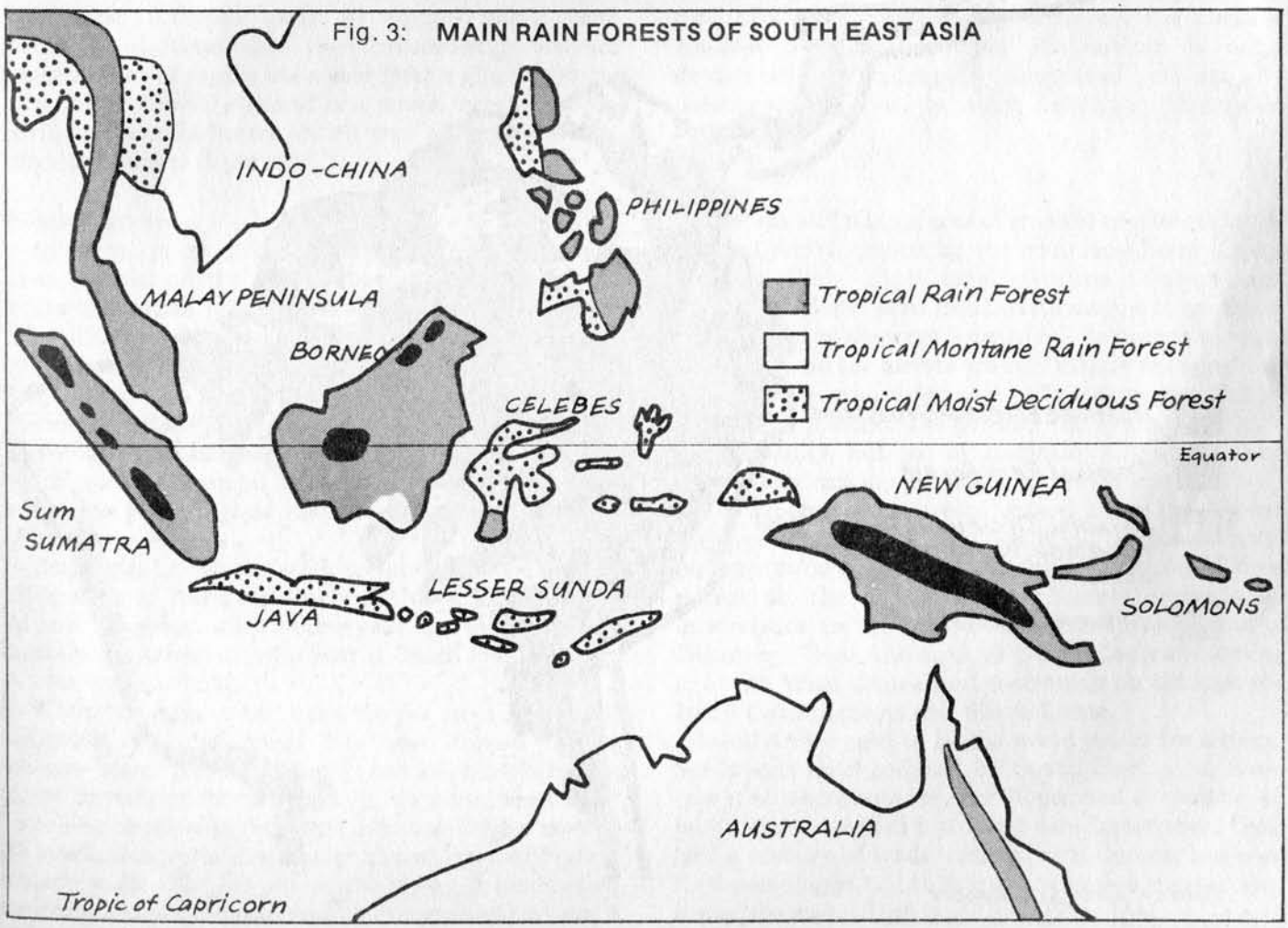
In 1977 Malaysia's Deputy Prime Minister, Mr Mohamed Mahathir, warned[13] that a national forestry inventory pointed to a depletion of Peninsular Malaysia's timber resources within 12 years if logging carried on at the same rate and reforestation was not stepped up dramatically. The lowland forests are almost completely logged out and wood is now being extracted from the mountain forests.

Mr Mahathir is Chairman of Malaysia's National Forestry Council, which has been meeting regularly since the late 1960s but only managed to agree to a national forestry policy in 1978. In Malaysia it is the State Governments, not the Federal Government, which control the utilization of forests. Timber provides them with their main source of revenue, while royalties from tin exports go to the Federal Government.

Malaysia has two states on the island of Borneo. Sabah is only two thirds of the size of Sarawak, yet until recently its timber production was nearly three and a half times greater. Sabah's forests are richer in commercial species than Sarawak's, which support a large number of shifting cultivators. Since 1977 log exports from Sabah have become progressively reduced (see below) and this could considerably lengthen the life of its forests.

The Indonesian part of Borneo, called Kalimantan, has now been fully parcelled up into logging

Fig. 3: **MAIN RAIN FORESTS OF SOUTH EAST ASIA**



concessions. Logging is in full swing on the island of Sumatra, and attention is now being focused on the last great area of forest which has so far escaped utilisation — Indonesian New Guinea or Irian Jaya.

According to Norman Myers: "Conservative estimates suggest that Sumatra and Sulawesi will have been logged out within 5-10 years, Kalimantan and most of the smaller islands within 10-15 years and Irian Jaya within 15-20 years. Given that present rates of exploitation are likely to speed up progressively, these time horizons could well telescope."[14]

At the centre of the Malesian archipelago are the Indonesian islands of Java, Bali, Sumbawa, Flores, Timor, Sulawesi, etc., in which climatic and other factors have brought about a covering of monsoon forests dominated by teak and pine, cutting the rain forest into western and eastern blocks. Java is one of the most densely populated regions in the world, with two thirds of Indonesia's 120 million people. It will come as no surprise that little of its native forest remains.

India still has a few fragments of rain forest remaining in the Western Ghats, but the early destruction of Madagasgar's forests caused the extinction of the famous dodo bird. The islands of Mauritius, Reunion, Rodriguez, and the Seychelles are all near the bottom of the same slippery slope.[9]

In the last years logging has started in the rain forests of Papua New Guinea which are similar in their flora and fauna to those of the north east Australian state of Queensland, both regions being on the Sahul shelf. Queensland is equal in size to Western Europe, and of its 170 million hectares it originally possessed 1.2 million hectares of tropical rain forest in a coastal belt centred on Cairns.

Logging began here in 1874, just one year after the first major expedition to the state, and no less than 213,000 cubic metres (cum) of the valuable Red Cedar

Fig. 4: **RAIN FORESTS OF LATIN AMERICA**


Source: UNESCO Report

*(Toona australia)* were shipped out in that year by just one logging party. Timber extraction has continued and clearance of the forest for sugar cane, maize and dairying has reduced its area by half.

Queensland does not have the best reputation for conservation in Australia. Perhaps the only factor which will ensure the survival of its remaining tropical rain forest is its inaccessibility in hilly and mountainous areas. Timber extracted from this forest is declining as a proportion of total production. The state is expanding its pine plantations to 160,000 hectares by the year 2000, and when productive they should be supplying 70 per cent of sawmill requirements. Hopefully this will also take the pressure off the natural forests.[15]

The tropical rain forests of east Malesia are not as rich as those in the west, and the quality of the flora gets gradually poorer as one continues east through the Solomon Islands, New Hebrides and Fiji. The isolation of the many small Pacific Islands has allowed the development and survival of many unique species, such as the iguana and the giant tortoise discovered by Charles Darwin on the Galapagos Islands, yet their small size also makes them vulnerable and their future uncertain. This is one of the reasons why this report concentrates on the three major areas of rain forest still extant.

Bougainville is a member of the group of Pacific Islands known as The Solomons (while part of the territory of Papua New Guinea) and used to be one of the most beautiful. Then a mining company came upon the scene, stripped away 37 square miles (9583 hectares) of forest, and then proceeded to extract 200,000 tons of copper ore a year from a gigantic open-cast mine! Now the island is a wreck, scarred by an artificial "amphitheatre which was all that was left after the miners departed."[16]

**South America**

In recent years the eyes of the whole world have been focused on the development of the 600 million hectare Amazon rain forests comprising over 54 per cent of the world's tropical moist forests. Three fifths of the total (360 million hectares) is located in Brazil, but substantial areas are to be found in Colombia, Venezuela, Bolivia, Peru, Guyana and Ecuador. The forests contain on average about 900 tons of living plants per hectare and altogether contain the largest collection of plant and animal species in the world, (Fig. 4).

Estimates of deforestation so far vary between one fifth and one third of total forest area, and Norman Myers estimates that every year up to 10 million hectares of forest may be lost in Brazil and 1 million hectares in Colombia.[14]

What was once seen from the air as a mosaic of different types of forest has been turned into a chequerboard of sylvan green and brown where the trees have been burnt to make way for large scale ranching or other agricultural schemes (38 per cent of deforestation in the Brazilian Amazon) or small farmer colonisation (31 per cent). Highway construction accounts for 26 per cent and timber extraction only 4 per cent. Sometimes the smoke from burning forests is so thick that pilots of aircraft flying over the area fly virtually blind. Dr Warwick Kerr, Director of the Amazonian Research Institute at Manaus predicts that the rain forest will have vanished by the end of the century if present trends continue.[17]

**Central America**

Tropical rain forest still remains to varying degrees on the eastern side of the Central American isthmus, particularly in Panama, Guatemala, Costa Rica, Nicaragua, Honduras, and Mexico. Costa Rica has made great efforts to conserve its forests,[9] while those of Panama are severely threatened according to a recent survey by Wadsworth.[18] Very high population growth rates of around 3 per cent mean that these forests are in danger of disappearing very shortly.[19]

Burgeoning populations, with each family claiming a patch of land to cultivate, threatens the wild stands of tropical pines such as *Pinus caribaea* which are being increasingly used for fast growing timber plantations. British foresters have been prominent in collecting seed in the area and in calling for conservation of its forest genetic resources.[20]

The Mayan Civilization had its origins in the rain forests of Honduras, later moving to Guatemala and Mexico. Already flourishing by the time of Christ, it made great strides in sculpture, painting, architecture, astronomy and mathematics before being crushed by the Spanish invasion in the 16th Century. The quetzal was the sacred bird of the Mayas and an important part of their culture. Today it is still the national emblem of Guatemala but its habitat is being destroyed and despite dedicated efforts by conservationists it is very much a threatened species.[21]

**Africa**

There is still a large area of tropical rain forest left in Central Africa, including the countries: Zaire, Congo (Brazzaville), Equatorial Guinea, Gabon and Cameroon. Zaire gains much of its income from copper exports and so does not have to fell its forests to make ends meet. So the forests are still mostly unlogged and provide subsistence for some 176,000 pygmy hunter gatherers.[6] Gabon, Congo, and the Cameroons have been steadily, but not dramatically, increasing their timber production since the mid-1960s. (Fig 5).

The tropical rain forests extend along the Guinea coast of West Africa in a belt lying between coastal mangroves on one side and the interior plateau of West Africa on the other.West of Nigeria there is an interruption in the form of a dry strip consisting of Dahomey, Togo, and most of Ghana, before resuming in South West Ghana and continuing on through the Ivory Coast, Liberia and Sierra Leone.

West Africa used to be the world centre for tropical hardwoods until eclipsed by South East Asia. Even now it still accounts for over 70 per cent of roundwood production in Africa's tropical rain forest area. Over half a century of trade, mainly with Europe, has seen its forests logged up to four times as new species have come into vogue. One study has shown that 60 per cent

of the volume of wood in the forest has been commercial at one time or another.[22]

The forests of Nigeria and Ghana are approaching exhaustion, and the Ivory Coast is losing 400,000 hectares a year through agricultural clearance and logging,[1] with a 30 per cent reduction between 1956 and 1963.[23] A whole chain of dense population nuclei stretch along the northern borders of the forest from Sewnegal in the west to Cameroon in the east, gradually cutting back the forest in order to cultivate crops such as cocoa.[6] Meanwhile large areas of mangrove swamps on the coast have been converted to rice cultivation.[24] About half of tropical Africa's area of cultivation is located in the humid region and the loss of forest just in West Africa is estimated at over 70 per cent with less than 20 million hectares remaining.[1] Nigeria's forest cover is now only about 20 per cent, and the Ivory Coast stands to lose almost all its primary forest by 1985.[25]

**"The Amazon rain forest will have vanished by the end of the century if present trends continue".**
**Dr. Warwick Kerr,** *Director of the Amazonian Research Institute.*

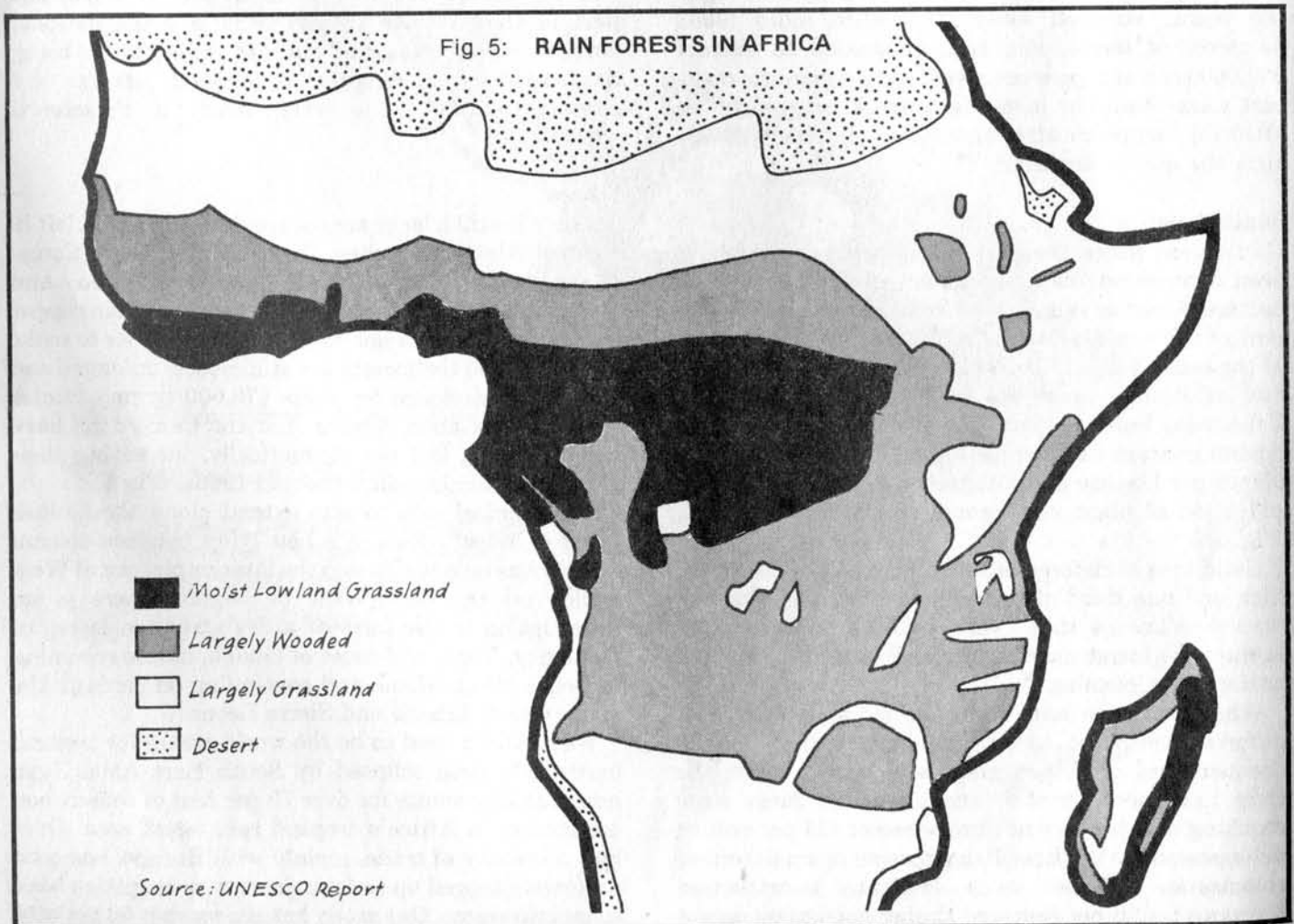
# THREATS TO THE FOREST

Traditionally hunter gatherers and shifting cultivators have lived in harmony with the forest. In Peninsular Malaysia, the Negritos subsist exclusively on what they are able to find in the forest whereas the Temiar cultivate rice and tapioca in clearings and vegetables in home gardens. One clearing is abandoned for another every few years, and while some groups stay in the same settlement for up to fifteen years, others will move with their clearing but staying all the time within hereditary tribal areas.[26]

Why must this change? In many cases the forest is not now allowed to return to its natural state after a few years of cultivation because the activities of loggers are driving forest people from their traditional lands and either turning them into landless cultivators who encroach on another tribe's area or compressing them into a smaller parcel of land which is used more intensively than before.

Other people will say that what is happening is a natural transition from shifting to permanent cultivation just as has happened in other parts of the world. It is difficult to separate this from the effects of

Fig. 5: **RAIN FORESTS IN AFRICA**



natural population growth since in both cases excess numbers have to leave the original community and make a new existence, clearing the forest as they go.

Massive forest destruction to establish cattle ranches is unique to Brazil and Australia, as is the extraction of timber from New Guinea's forests by outsiders. Otherwise the threats to the forest are not clear cut but very inter-related. The tracks and roads constructed by the loggers to get to and from their concessions are also used by landless people in search of a new area to grow food. While there may be a great deal of external investment in logging, very often it is the forest countries themselves who are trying as hard as possible to export their wood.

The way in which that wood is being extracted, by loggers concerned purely with removing trees from the forest as quickly as possible, is very much a threat to the forest's continued existence. The comparatively small number of qualified foresters, who think in terms of the long term management of the natural resource, are usually preoccupied with administrative or research duties and so the loggers are unsupervised.

The shifting cultivators and hunter gatherers rely upon the forest for everything, and their need is very different from the greed of Amazon cattle ranchers out to make a quick profit before soil fertility is exhausted. On the other hand logging can considerably enhance the economy of an area, providing both money and jobs, albeit temporarily.

Ironically both the foresters and the shifting cultivators depend upon the sustained productivity of the forest, yet the changes being enforced upon the forest people by the loggers are as important from the point of view of forest degradation as is the threat by encroaching cultivators to a timber stand after or even before it is logged. It is this vulnerability which the logging companies use as an excuse for not investing in the continued production of timber from the patch of forest which they have logged.

It is generally very difficult to lay the blame for deforestation at the feet of any one group of people or company. The only thing that we can be certain about is that the forest is disappearing and when it does *everybody* will suffer. The purpose of this and the following chapter is simply to examine in more detail the main causes of deforestation in the hope that from that understanding some strategy for rational use will develop.

# The Shifting Cultivator Changes Direction

### Traditional Shifting Cultivators

The Yamomamo Indians occupy a territory straddling the border between Brazil and Venezuela. To cope with the low fertility of the land they practise shifting cultivation, cutting down and burning the trees in the dry season then planting any combination of up to 50 species on land which has a temporary fertility owing to the layer of ash from the burned vegetation. 75 per cent of their food is composed of bananas and other plantains and is supplemented by nuts, palm fruits, tubers, wild bananas, and wild honey gathered from the forest. After a year or so, when the fertility of the land is exhausted, they go on to clear another patch of forest. Hunting is by bow and arrow or blow pipe, although large mammals and birds are not abundant.[27]

The Yamomamo are a typical example of traditional shifting cultivators and their presence in the area was recorded as far back as 1707. The population densities of shifting cultivator societies are commonly between 4 and 15 persons per square kilometre and usually less than 40/sq. kilometre. This compares with a density for hunter gatherer societies of between 0.005 to 0.12 persons/sq. kilometre.[25] The Maya were the only people to build an advanced civilisation on an economic base of shifting agriculture, although this is difficult to equate with the evidence that their population density was over 300/sq. kilometre.[21]

One argument frequently put forward to explain deforestation is population increase. Yamomamo numbers are increasing at 0.85 per cent per annum, but the population density is still less than 0.4/sq. kilometre. Populations have been traditionally controlled by infanticide and inter-village warfare, but with the intrusion of colonists comes a new source of mortality caused by both the guns and the germs which they carry. In a recent measles epidemic 17 per cent of the population of some Yamomamo villages died.[5]

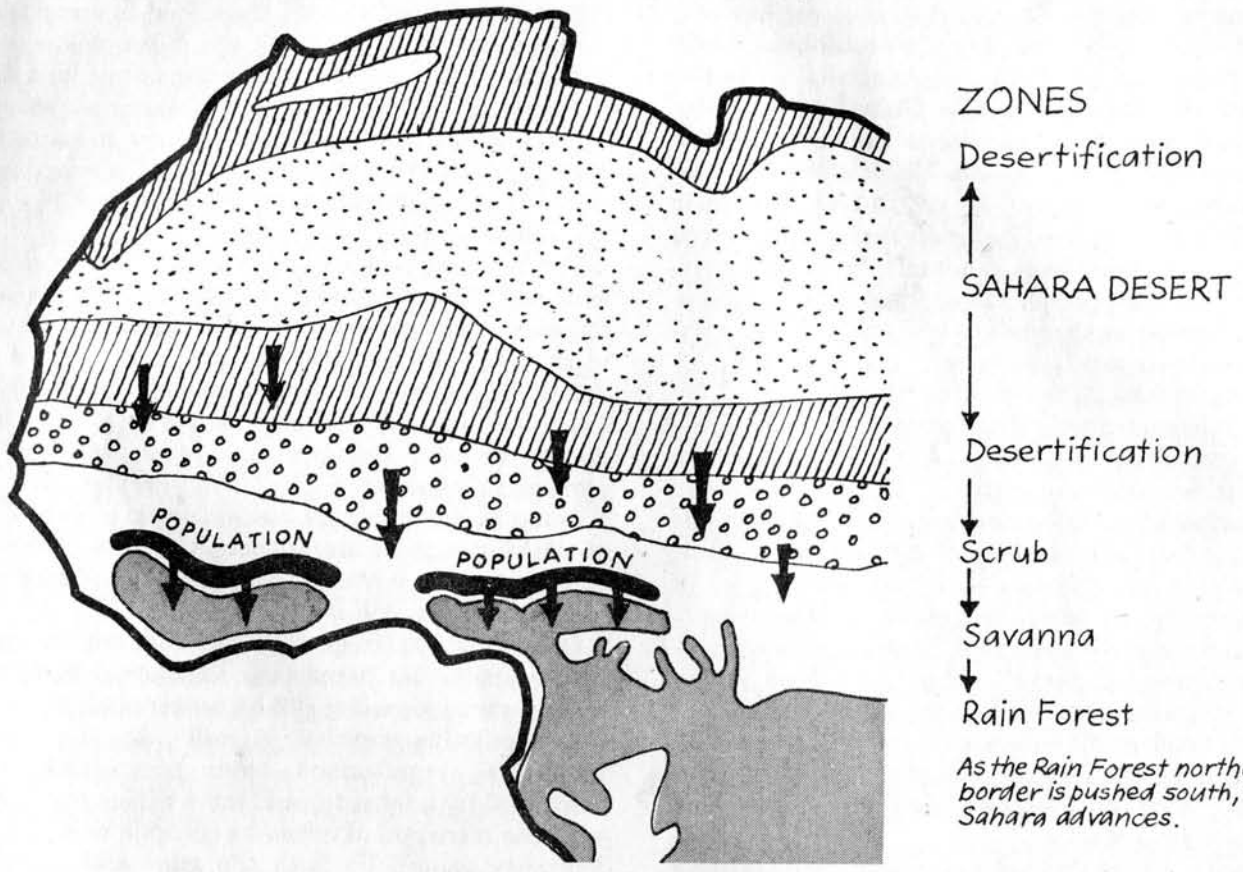
The Iban and Land Dayaks are two groups of shifting cultivators in Sarawak on the island of Borneo. They are recent immigrants from the interior of Borneo, from which they were 'evicted' by loggers. They both inhabit fairly hilly country, but while the Land Dayaks use the same area of land continuously (under rotation) the Iban clear a new patch of forest every one or two years, either moving their main settlement or establishing a 'satellite' settlement nearer to distant cropping land.

### People in Transition

The Iban and the Land Dayaks represent traditional societies in transition. Both grow rubber as a cash crop, but still continue to grow their own rice despite the profits which could be made from rubber. Many young Ibans travel away from their own community to work and trade for months or perhaps years at a time, and this is an important part of the Iban economy. The Land Dayaks attach less importance to this but engage in more intensive agriculture, growing wet rice in the swamps as well as dry rice in the hills. More sedentary than the Iban, the Land Dayaks had a population growth rate in the 1960s which averaged 3.37 per cent compared with 2.26 per cent for the Iban.[3]

Professor Soedarwono Harjosoediro of Gadjah Mada University, Yogyakarta in Indonesia, in a study on shifting cultivation prepared for the 1978 World Forestry Congress estimated that traditional shifting

Fig. 6: **FOREST DESTRUCTION AND DESERT ADVANCE IN WEST AFRICA**




cultivation (in South East Asia) forms only 5 per cent of the total population engaged in all forms of shifting cultivation (an estimated 250 million people).[28]

While he admits that population growth is a pertinent factor, he argues that there is an "increasing . . . need for a solid and comfortable home life among the cultivators." This requires that the fields which are shifted are not far from their homes and consequently the fallow periods become shorter. "The shorter the length of their shifting cycle the stronger is their social life. A shifting cycle of 5 to 6 years indicates the existence of a stable settlement living mostly on shifting cultivation. A rotation of 3 to 4 years could form the border line between shifting cultivation and sedentary agriculture as semi-permanent and permanent plantations begin to take over from the annual crops." Typical perennial crops grown would be mango, cocoa, bananas and coffee.

Stable or semi-stable shifting cultivators like the Land Dayaks just use a bush fallow system in which land is left for less than 10 years and quite often for not more than 5 years before being cultivated again. The continual burning of the shrub restricts regeneration of forest trees and probably results in a permanent transformation of the ecosystem.

**Rootless People**

Soedarwono claims that most devastated lands of the tropics are caused by this type of shifting cultivator. The very stability of a settlement implies that any increase in population beyond that which can be supported by shifting cultivation of the adjacent land must be balanced by migration to distant areas of the forest on the part of some members of the group.

Erik Eckholm concurs with this view: "Many of the 'shifting cultivators' wreaking the greatest forest destruction today are not traditional practitioners of this art at all. They are rootless, landless people, often squeezed from their homelands by unequal land tenure or population growth, who are struggling to make what living they can amidst unfamiliar ecological conditions." Among the factors which Eckholm quotes as leading to landlessness are the invasion of the forest by logging companies and the spread of plantations.[29]

Venezuela has a high rate of unemployment and rising numbers of landless peasants. A local forester, Herman Finol U., estimates[30] that some 50,000 families are responsible for the clearance of 85,000 hectares of forest every year. Further south, one hears of the incredible activities of "weekend shifting cultivators" who are obsessed by the need to leave their urban or semi-urban areas at week-ends to practise slash and burn cultivation in the Amazon rain forest. I'm sure they see it as their God-given right to cultivate a piece of land just like an English allotment holder. Also present must be a subconscious desire to help push back the frontiers of wilderness and expand civilisation. This factor is very significant in Brazilian thinking at the moment.

The senior forestry advisor to the World Bank, Mr John S. Spears, forecast in his address to the 1979 Annual General Meeting of the Commonwealth Forestry Association that the remaining tropical forests will disappear in about 60 to 80 years time

because of expanding land-hungry rural populations in 24 countries.[31]

The World Bank, in its Sector Policy Paper on Forestry, agrees that "the expansion of encroachment and shifting cultivation is the major source of forest depletion" and estimates that every year in East Asia, 25 million encroaching cultivators clear between 8 and 10 million hectares and cultivate over 100 million hectares of land that was once forested. Perhaps 30 per cent of land officially described as forest in South and South East Asia could be used in this way. Elsewhere, in Africa shifting cultivators have been pushing back the northern border of the West African rain forest, clearing at least 100 million hectares so far this century,[7] with expansion of cocoa plantations being a major cause.(Fig. 6).

**Resettlement and Colonisation**

As well as the unofficial migration of encroaching cultivators into the forest, a number of countries with rapidly rising populations are organising large scale clearance of jungle for the purposes of resettlement. Malaysia's schemes at the moment encompass 2 million hectares in Borneo, and a 13 year programme scheduled to end in 1981, by which time 44,500 acres of virgin jungle in Pahang State (Peninsular Malaysia) will have been cleared for small holdings growing oil palm, rubber, cocoa and coffee tended by over 8,300 landless families who are guaranteed an income while the crops mature.[32]

Indonesia intends to clear 18 million hectares over the next 20 years, mostly in Kalimantan, for the resettlement of people from overcrowded Java, but things are not going too well at the moment and in October 1979 President Soeharto visited the 'transmigrants' to hear their grievances. The soils of the lands which they had been allocated were on the whole so poor that it was impossible for many to grow enough for their own subsistence and they had begun to suffer from malnutrition and poor health.

A number of farmers were driven to tears when speaking to the President and asking for his help. Many of these could well join the ranks of the landless shifting cultivators and cause further forest degradation if action is not taken quickly.

Another President, this time President Medici of Brazil, was so moved by representations made to him on a visit in the late 1960s to Brazil's dry, overpopulated and poverty stricken north east region that he promised to resettle many of them in the 'land of milk and honey' — the Amazon Basin. They would be helped by low cost housing, free land (100 hectares per family) and easy credit. New roads would be built along which they could settle.[14]

He hoped to resettle up to 5 million people by 1980. After two years only 100,000 had come, and they didn't like what they found: heavy rain, insects and unfamiliar diseases, but worst of all, the fertility of the land was spent after it had delivered three crops. Most of the disillusioned settlers went back to the North probably thinking — "better the desert we know than the desert we don't know."

Table 3: **THE ROLE OF INTERNATIONAL AID IN FINANCING HIGHWAY CONSTRUCTION IN THE AMAZON BASIN.**

| Principal Roads of Transam. system | Indigenous Territory Invaded | International Finance and Tech. Assistance | Multinational Corporations |
|---|---|---|---|
| Transamazonica highway: 4,960 Km linking the North-east to Peruvian border. | *Juruna, Arara,* Parakana, *Asurini, Kararao.* | The World Bank: Loan of US$400 million to DNER: largest road-building loan in Bank's history. | Earth Satellite Corp. Litton Industries/ Westinghouse Corp. contracts for Proj. RADAM for aerophotometric studies, value US$7,000,000. |
| Belem-Brasilia highway: north to south from the the west bank of the Amazon. | *Gaviao, Kraho, Apinayé, Xavante, Xerente* | Export-Import Bank: loan of US$3,898,350 to Camargo Correa, Brazil's major construction co., for equipment purchase | Caterpillar Brazil: sale of 770 pieces of machinery to value US$47,000,000 to army engineering corp and 7 private co.s building road in Amazonia. |
| Santarem-Cuiabá highway: north to south through centro-west: inc. BR-080 | *Xingu National, Park: Kren-Akrore* | USAID: donation of US$8.4 million for training in data use in Earth Resources Observation centre, Sioux Falls, S. Dakota. | Komatsu (Japan), Fiat (Italy), General Motor, J.I. Case, Clark Equipment, Eaton Corp., Wabco, Huber-Warco (USA), & other foreign companies with tractor equipment worth US$125,000,000. |
| Northern Permiter Highway: 4,000 Km along the borders of Brazil with Guayana, Surinam, Venezuela, Peru, Columbia. | *Tucumaque Park, Waimiri-Atroari, Yanomami, Atalaia Park (?)* | | |
| Porto Velho-Cuiaba highway: principal road across Mato Grosso and Rondonia | *Aripuana Indian Park: Cinta-Larga, Surui Munxor* | (*From:* Davis 1977: 81:) US$1,000,000 from US Army to BEC for heavy construction equipment; USAID: loan of US$2.6 m for construction of 14 permanent bridges on road. | |

*SOURCE: SURVIVAL INTL.*

**What Happened to the Highways?**

The main instrument by which Brazil would civilise the Amazon Basin was a massive highway system, whose leading light would be the Trans Amazonian Highway, designed to stretch nearly 5,500 kilometres from the overpopulated North East region to the westernmost part of the Amazon. Construction began in September 1970 less than three months after President Medici's announcement. Along this spine, agricultural projects would extend for 100 kilometres on either side of the road.

Both smallholders and ranchers alike had to leave at least 50 per cent of their land under forest as a sop to environmental interests but this rule was never taken seriously. In practical terms the forest could still be destroyed by the simple expedient of one landowner selling his 50 per cent of forest to another who would then proceed to clear half of what he had bought. (Fig. 7, see page 33).

Details of what has happened to Brazil's highway dreams are difficult to come by. The Brazilian Embassy in London does not possess a road map more recent than 1974. What is clear is that road construction was severely reduced after the millions expected to flee along it from the North East did not materialise. The TransAmazonian Highway is just a two lane dirt road, now mostly neglected subject to flooding and in some places being colonised by the forest instead of people. One of Sao Paolo's newspapers has called it "the most useless highway on the face of the earth."[33] Substantial foreign aid has been involved (Table 3).

While the 37 million inhabitants of the North East have largely ignored the Amazon, people from areas on its southern fringe have been more enthusiastic despite poor medical and other social facilities. Tens of thousands have flowed along roads leading from Cuiaba to Santarem and from Cuiaba to Manaus via Porto Velho, the latter part of which is tarmacked. Another main road, between Brasilia and Belem, is the nucleus for about 1 million settlers.[34] (Fig. 8).

As far as smallholder settlement is concerned, the future is very uncertain, with destitute and disease-ridden families returning home at the same time as other immigrants are arriving to build a new life in the jungle. From the point of view of logging and mining companies and large scale farmers, the roads that have been built are a mixed blessing. Firstly it is just not economic to transport logs or minerals thousands of miles along a road, and river transport is far cheaper.

Secondly, even the short distances of highway used to connect logging camps with rivers may be flooded during the 6-month rainy season.

The future of some roads like the Northern Perimeter Highway, which was proposed to serve to delineate Brazil's northern border and connect the potentially important mining area of Roraima to the Atlantic, is difficult to assess with latest reports indicating only partial completion. From the results so far it would seem that Brazil would be far better advised to invest in the transport capability of its 50,000 kilometres of navigable waterways than in a road network which has resulted in clearance of more than 18 million hectares of forest.

**Home, Home on the Range**

Although mass immigration from the North East did not live up to expectations, the Brazilian Government was assured by its experts that there was at least 500 million acres of land with potential for cultivation in the Amazon. With a population not far short of that of the U.S.A., Brazil was only cultivating 74 million acres against the U.S.A.'s 300 million acres so all land was going to waste.

Brazil is the world's third largest cattle country, with a population of 95 million head in 1973. It exports more beef to the U.S.A. than any other country in Central and South America — more that 33 million kilograms or nearly 74,000 head in 1976. Most of this cheap beef goes to make hamburgers or frankfurters, and MacDonald's, the largest hamburger chain, sells 3 billion hamburgers every year using 300,000 head of cattle and has gross sales of 3 billion dollars.[35]

It was natural then, that when the Government called in the big multinational companies such as Volkswagen and Liquigas to help it out with it's Amazon problem, it should suggest that they establish cattle ranches, and give them land at £25 an acre (compared with £1500 for an acre of prime English farmland) plus tax rebates and other grants.

First on the scene was the King Ranch, which has a very large 1,000,000 acre ranch in Texas and a 50,000 acre holding in Queensland, Australia where the climate is similar to that of the Amazon, with 168 inches of rain on average in a year and sometimes over 300 inches. Altogether their Australian holdings total 9.75 million acres, and although this dwarfs their 530,000 acres of rangeland in South America at the moment, they are continually expanding.[5]

The Volkswagen Foundation runs a ranch half way between Brasilia and Belem with an overall size of just less than 140,000 hectares (300,000 acres) bought at a cost of 50 dollars a hectare in 1974. The nearest road — the newly built Belem-Brasilia Highway is 80 kilometres away by dirt road and on the other side of the River Araguia, a tributary of the Amazon. Volkswagen had to build the last 40 kilometres of road themselves, as well as no less than 35 bridges. In 4 years they have cleared 22,000 hectares and on that are grazing 20,000 head of cattle. There aren't many people on the ranch, about 200 workers and their families makes for a small village of about 500 people, which will rise eventually to about 1000 people. They have their own school, hospital and other facilities.[35]

A nearby ranch is owned now by Liquigas, an Italian firm, although it was developed in the 1960s by one of the rich sugar magnates from Brazil's North East. It is 1000 miles from the Volkswagen Ranch and encompasses what used to be 1.3 million acres of virgin forest. Now 180,000 acres of that has been cleared and holds 96,000 head of cattle. In the early 1980s they hope to be slaughtering 30,000 head every year.

These are just two of what must now be hundreds of ranches springing up all over the Amazon. By English standards there they are vast — even the present area of 180,000 acres of the Liquigas Ranch dwarfs a large sheep farm in the South of Scotland which will reach to 2500 acres, and is twice the size of a sheep station in New Zealand of about 90,000 acres. When all of the 1.3 million acres are cleared it will even surpass King Ranch's operation in Texas.

The object is, of course, to grow and slaughter cattle as cheaply and as quickly as possible. It takes little money to purchase the land and even less to build a dirt road, a few bridges, and the buildings for the workers and animals. There aren't many workers either — on average about one per 1000 head of cattle. So the running expenses are also low. The Liquigas Ranch only has 114 workers on the ranch with 30 more outside and 400 more seasonal workers..

The most labour intensive operation of all is the slaughtering. A new slaughterhouse is being built near the Volkswagen and Liquigas ranches to cull cattle from the eight ranches in the area, and it will need about 600 workers.

But while all these cattle are being raised, and slaughtered what is happening to the forest, and to the soils which are exposed once it has been cleared?

While even shifting cultivators in Africa may have chain saws these days, in the Amazon they still use the axe. When the rainy season stops a hundred men start work on the Liquigas Ranch, each clearing several acres a day. Many trees have relatively soft woods and so come down easily, while some have such hard wood that its just hopeless trying to fell them. Thousands and thousands of acres are strewn with rubble which was once a proud forest.

**Conflagration**

At the end of the dry season the wood is so ignitable that it will burst into flames at the touch of a match. Let Anthony Smith, who went to the Amazon in 1978 on behalf of the B.B.C.[35] take up the story:

> "One match was struck and almost instantly flames were leaping well above our heads. There was no huffing and puffing as there is with many a damp English bonfire. Instead, and with a roar, the flames set about their work. We watched whole trees become seared of every leaf. The smoke rose a thousand feet into the sky, and within an hour, the fire had done its work.
>
> "About twenty square miles of cut down forest had been dealt with in the most summary fashion. An English bonfire once lit will last for hours, even days, but this forest furnace, so fierce, so all consuming, so incredibly hot, had done its work between 8 and 9 a.m.

"Within another 30 minutes it was possible to walk within this kind of Passcheandale; to tread on black earth, to walk by black trunks not totally consumed, and to kick blackened termite mounds . . . It was a cremation of a most terrible kind."

**The Forest Fights Back**

After the forest has gone, man is still in a constant battle with nature. It takes a couple of years before the land is ready for cattle. First of all it is colonised by pioneer trees but they are unable to stand the dry season, and wither and die. So next year there is more fire, and the year after that. In the third year grass is planted, and it reaches to 8 feet in a couple of months.

This long grass, typical of the African savanna lands where once too there were forests, is important, because it helps to prevent the regeneration of the forest and other vegetation. Early on it is possible to graze one head of cattle per acre, and later this may rise to two. This is after further burnings of the grass, which gets hard and inedible in the dry season. But if there are too many cattle, then so much grass gets eaten that the forest can start to get a grip on things again, and if the dry season is too wet, then the grass cannot be burned before the rainy season starts again and this also gives the forest its chance to fight back. Of course there is the ever present risk of soil erosion, and the wiser ranchers limit the carrying capacity of their ranges to less than one animal per acre on average, to avoid most of the erosion, as much as preventing the forest getting the upper hand once again.

There is no assurance that the ranchers will be wise in their use of the land which has now become sucked into the great global beef industry, and as anonymous as a criminal entering a prison for a long sentence. So far 6.6 million hectares of forest have been cleared to accommodate 6 million cattle on about 300 ranches.[14]

Productivity is very low, even just after the forest has been cleared. The stocking rate per hectare is only one tenth of that of ranches in other parts of Brazil, and so far the Amazon ranches only account for a fraction of Brazil's total beef exports, worth an annual 25 million dollars, although the hope is that with America's seemingly insatiable demand for beef, the contribution will grow larger in the next few decades.

The productivity is low not only because of the poor soils, frequently deficient in calcium, but because of the effect of the climate on the overall efficiency with which the cattle gain weight and reproduce. How long the cattle will stay in the Amazon is debatable: after clearing the forest grass may grow naturally up to half a metre in Colombia but resemble the fairway of a golf course in just five years because of nutrient loss. Ranchers tend to want to clear more virgin forest when productivity falls below a critical level, rather than apply fertilisers, and there could also be a considerable risk to the cows from diseases which can develop rapidly and soon become endemic as in the case of Africa.[36]

Brazil's population is generally deficient in animal protein and despite hopes that the Amazon's cheap beef could help alleviate home food shortages it seems that even this is becoming too expensive for local people. Already forest clearance has sent 7.7 billion dollars worth of timber up in smoke and the Amazon ranching experiments could prove to be one of the most profligate misuses of natural resources in history. The Government agency SUDAM spent 391 million dollars between 1965 and 1979 in assisting 187 ranching projects. Subsidies have now ceased and 85 per cent of ranches in a major area around Paragominas were out of business by 1977 because of the severe limitations on productivity.[37] It will probably take a considerable time to calculate the true costs of Brazil's "wild west days".

**Mining**

Tropical rain forests are usually associated with mineral wealth. Zaire is a major source of copper, and Malaysia, Thailand and Indonesia will be first second and third leading tin producers in the world in 1979.[37]

Brazil is no exception but exploitation of the Amazon's vast mineral reserves is only just beginning. These contain the world's largest reserves of high grade bauxite and iron ore, together with tin and uranium ores, diamonds, uranium and an estimated 30 billion dollars of gold.[38]

The Serra dos Carajas (iron mountains) contain more than 18 billion tons of almost solid iron ore with a 66 per cent proportion of haematite. Extraction was to have been a joint venture between Brazil's National Steel Corporation C.V.R.D. and U.S. Steel, but the latter pulled out after investing 50 million dollars in the project. Despite this the project is being resuscitated. Extraction of tin ores in Roraima is likewise just beginning.

One project which is well advanced is extraction of bauxite from an estimated three billion tons reserve on the Trombetas river near its meeting point with the Amazon. Production is scheduled to begin soon at an initial level of 3.35 million tons per year rising to 8 million tons per year. The investment has been arranged jointly between the Brazilian Government, Reynolds Aluminium and firms from Canada, the Netherlands, Spain and Norway.

Unlike the Carajas operation, which will necessitate an 876 kilometre railway journey along a specially built line to the coast, the bauxite from Trombejas can travel easily along the Amazon river to a port for transhipping and export, but by 1983 when the Tucuri Hydroelectric Power Station opens, there will be enough power to process the ore in Brazil before export.

Perhaps the latest adventure in the Amazon saga will be managed a bit better than was the introduction of cattle ranching. Deep mines can of course create small disturbances to the forest but environmentalists' eyebrows are raised very quickly should the word 'opencast' be mentioned.

But the Brazilian company in charge of the project, Mineracao Rio do Norte (MRN) has taken on the FAO ecologist Harry Knowles whose sceptical comments about the formation of a new Sahara in the Amazon Basin are quoted elsewhere in this report.

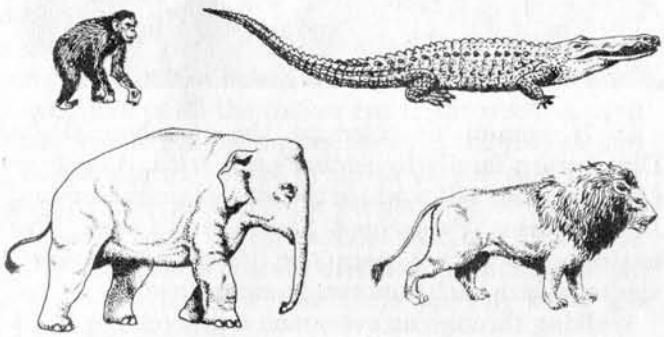
Accordingly, botanical, zoological and other inventories are being made of forest areas before the

trees are stripped from the surface, when they will be utilised in the most efficient way possible, either commercially or for local construction. The average rate of deforestation is only estimated at 72 hectares per annum, including port, administration, processing and other facilities.

The soil is being restored after exposure of the bauxite seams and when replaced will be planted with plantations of fast growing trees. Other measures are being taken to reduce air and water pollution. If things do go to plan then this particular project might well become the showpiece that Ludwig's Jariland already is.

Brazil intends to increase its exports by 266 per cent by 1984 to reach 40 billion dollars. As the world's largest debtor it has to spend 9 billion dollars a year on servicing its huge foreign debt of 50 billion dollars. It will have a projected trade deficit in 1979 of 2 billion dollars, with crude oil imports of 7 billion dollars accounting for half its exports. No wonder then that it is investing huge sums of money in fuelwood plantations, coal and oil exploration in order to become more self sufficient in energy.

## The Wild Life Trade



Depletion of the forest ecosystem is also caused by the exports of its inhabitants to stock bird cages, fish tanks and zoos in the developing world, or to make fur coats, souvenirs or aphrodisiacs. The skins of ocelots are openly sold in Mexico or in towns along the Amazon river[39] and coats made from their fur can sell for 40,000 dollars in Germany.[40]

About 100 million wild birds are trapped every year to be sold as pets. Birds like the Mynah are getting rarer or disappearing altogether from their normal ranges.[41] An Amazonian parrot can sell for 5,000 dollars as could a single orchid whose capture has probably cost the lives of more than one tree in the rain forest. Powdered rhinoceros horn is bought by men worrying about failing virility for more than the same weight of gold would cost.

There has been increasing international action to curtail the trade in wild animals, notably the Convention on International Trade in Endangered Species of Wild Fauna and Flora which came into force in July 1975 and to which 51 nations are now signatories. However there are gaps, for while export of macaque monkeys was banned in Thailand in 1975, it is still legal in Indonesia. Between 1970 and 1975 it exported 91,000 macaques mostly for medical research.[40]

With a continuing heavy demand for fur coats and crocodile handbags, a lot of the trade has simply gone underground and smuggling wild animals is now a multi-million pound industry. One of the major routes is between Mexico and the U.S.A. and in 1976 more than 1000 rare lizards, snakes, crocodiles and tortoises were smuggled[42] into the U.S.A. by means of such devices as secret compartments in cars.

Occasionally illegal trade surfaces in well publicised court cases. In January 1979 the House of Sears, a London store, was fined £550 with £50 costs for putting on sale three leopard skins valued at £4250. In 1978 an American was fined 87,500 dollars and given eight months in prison for exporting 2.500 American alligator skins valued at 1 million dollars.[40]

The trade in turtles involved over 100,000 creatures in 1977, destined to end up in turtle shell products, soup, or (increasingly) leather goods. In 1978 2,000 skins of birds of paradise were exported from Indonesia every month despite being fully protected in that country. Some are undoubtedly smuggled from Papua New Guinea where a trader can also expect to receive up to £400 for a single bird wing butterfly. In 1977 the officially registered exports of wild cat skins reached 615,000[43], and in March 1978 a single consignment of 40,000 skins of caiman crocodiles was exported from South America for processing elsewhere.

The terrible conditions under which even legally exported animals have to travel was brought to the public attention in mid 1979 when a consignment of hyenas from South Africa was stopped at Rome Airport and most had to be destroyed because officials were not satisfied about health standards. This was just a few weeks after customs men at London's Heathrow Airport stopped the passage of a live baby orang utan from the Far East because they were not happy about the legality of its export.

In 1977, 2000 dead birds were found packed 300 to a box at Heathrow after a flight delay in Kuwait of 2 days. A Royal Society for the Protection of Birds survey of 1800 cages containing 150,000 birds travelling through Heathrow in the first five months of 1976 found that none of the cages was up to standard[44]. Mortality rates for travelling animals are high, estimated at 90 per cent for gibbons, 80 per cent for hummingbirds and between 70 and 80 per cent for ocelots who have not been killed first for their skins.[45]

Each one of these animals represents a loss to the forest. In order to safeguard its wildlife, Papua New Guinea has given a welcome lead in starting to cultivate crocodiles on farms. At the moment between 30,000 and 50,000 skins are being exported every year from 200 farms. While this is encouraging, vigorous efforts must be continued to curtail both legal and illegal sales of endangered species, remembering that no less than 76 animal species have become extinct in the past 50 years.[40]

# WHERE DOES ALL THE WOOD GO?

The tropical lowland evergreen rain forests contain a greater number of species than any other rain forest and are the most luxuriant regions of vegetation in the world. They are dominant in the large areas of Malesia possessing a permanently humid climate but are probably absent from Africa and in South America are restricted to areas near the mouth of the Amazon and the foothills of the Andes and Guyanas mountains.[9]

**Dipterocarps — Kings of the Forest**

Between 1800 and 2300 tree species with trunks greater than or equal to 10 metres in diameter have been identified in Sarawak and Brunei.[46] The kings of the malesian rain forest are the 385 species of the Dipterocarp family, whose Asian members number about 470, all of which are woody and inhabiting mainly permanently humid areas.

These giant trees can reach to more than 45 metres (147½ feet) and are called emergents because of the way in which they push themselves above the main forest canopy which may be between 24 and 36 metres above ground level. Evergreen rain forests are characterised by a large number of emergent trees.

It is helpful to refer to the members of the Dipterocarp family by genus, e.g. *Vatica*, *Anisoptera*, *Dipterocarpus* (after which the whole family is named), *Dryobalanops*, *Parashorea*, *Shorea*, and *Hopea*. There are only 10 such genera and the large number of species which each contains is exceptional.[47]

Walking through an evergreen rain forest, or around Java's famous botanical gardens at Bogor where the Dipterocarps are all lined up for inspection, even an expert would find himself hard pressed to identify the species or the genus of a particular tree. They all have similarly shaped leaves with the characteristic 'drip tips' to facilitate the passage of water from canopy to the ground. Asia has yet to invent the tropical equivalent of a famous British dendrologist who, it is rumoured, is able to identify the species of a tree at a distance of one mile.

While over 90 per cent of the tree species in Sumatra, Borneo and Peninsular Malaysia occur in all three countries, extensive forests of Dipterocarps occur only in the western half of the archipelago.[9]

**Valuable Woods**

Dipterocarps are hardwoods but lighter than the cabinet timbers such as mahogany and ebony which were the first prizes from the tropical rain forests to reach the West. A timber merchant has to guarantee to supply his customers with wood of a specific quality, and until very recently achieved this by asking loggers

to select only a small number of the many species found in these forests. Species-based marketing is obviously very much influenced by the produce from temperate forests containing relatively few species. The African tropical rain forests have been logged a number of times, extracting new species as they become accepted on the world market.

This 'creaming' process is very inefficient from the loggers' point of view as comparatively few trees can be harvested from a hectare of forest. The unique presence of large concentrations of Dipterocarps possessing similar and high quality woods has attracted loggers from all over the world like a magnet to the Malesian forests.

Light hardwoods are attractive to the timber trade because they are easy to work and flexible in use, and today groups of species are sold under a single name such as red meranti (*Shorea spp.*), white and yellow meranti (*Anisoptera spp.*), white seraya (*Parashorea malaanon*) and keruing (*Dipterocarpus spp.*) which a merchant may buy confident of obtaining timber whose properties vary between specified limits.[48]

**The Importance of Firewood**

Despite the fact that a considerable amount of forest is just razed to the ground to provide agricultural clearings, a significant volume of wood is cut for the local and national markets. But how is it used? Our preoccupation with oil shortages in the developed world makes us neglect the overwhelming dependence of most of our fellow human beings on firewood. Only a century ago, the U.S.A. obtained three quarters of its commercial energy from wood, which still accounts for 7 per cent of global energy consumption.[49]

Nearly half of all the timber cut in the world is used for fuel. In the developing countries of the tropics it is the staple energy source of up to 90 per cent of the population and accounts for 80 per cent of the wood consumed in those countries. Less than one fifth of the wood felled in the tropics is destined for industrial use and only one third of this finds its way onto the international market.[50]

**The Trade in Tropical Logs**

Since the war the forests of the developed world have not been able to keep up with the demand for industrial roundwood. We are still, in this plastic age, far more dependent on wood as a basic raw material than we realise. In the U.S.A. three quarters of all houses are made mostly from wood, and an estimated 7000 dollars worth of wood went into every new house started in 1978. About 43 per cent of the 2500 million cubic metres (cum) of wood felled in the world is used for constructional or other material purposes, while 10 per cent is used to make pulp and paper[14] (Fig. 8).

This growing gap between supply and demand has been met by the tropical rain forests.[51] With the temperate world's concentration on coniferous softwood plantations, tropical hardwoods have found a ready market for constructional purposes, furniture, plywood and veneers.

Between 1950 and 1973 the developed world's imports of tropical hardwoods increased from 5.2

Fig. 8: **WORLD WOOD USE**

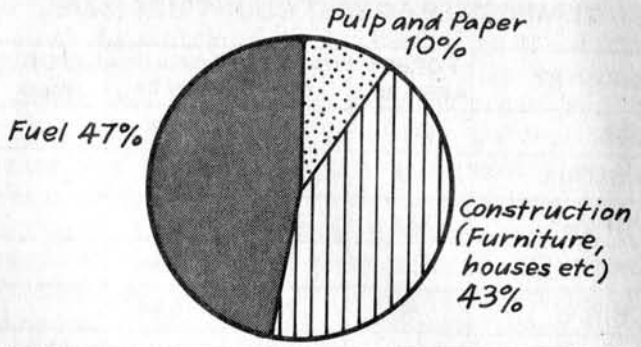
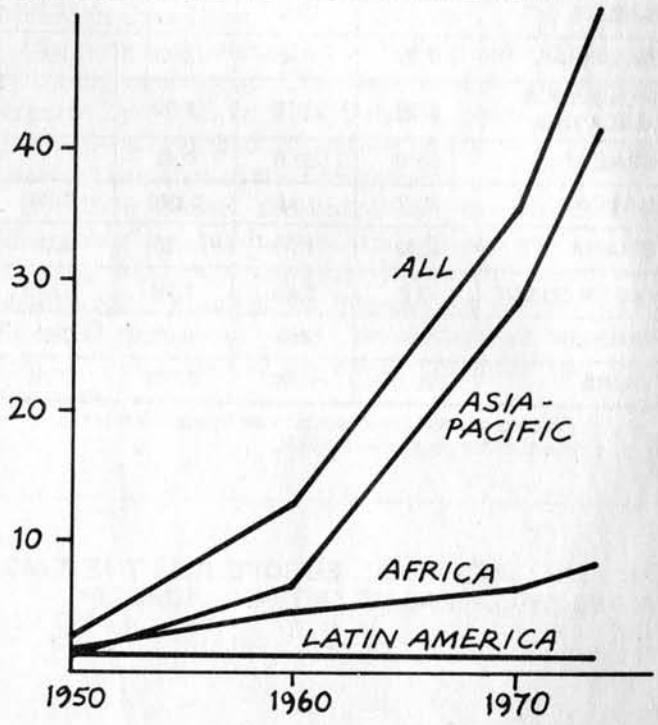



Fig. 9: **INCREASE IN EXPORTS OF TROPICAL LOGS - the rise of Southeast Asia**




million cum to 52 million cum when they accounted for 11 per cent of total world industrial wood removals. The value of these imports increased eight-fold from 500 million dollars in 1961 to 4000 million dollars in 1975.[52] (Fig. 9).

F.A.O.'s projection for industrial wood consumption in 1994 is 4000 million cum — a 60 per cent increase on 1975. The growth in commercial extraction from tropical forests has been growing far faster than that from temperate forests since the war, and over the next two decades tropical removals is expected to have grown at twice the rate of temperate removals in order to keep up with demand.[53]

**Processing is the Key**

About 85 per cent of the total world trade in forest products occurs between developed nations, and in 1975 the value of logs exported from developing countries was only 5.3 per cent of this total trade. Part of the reason is sheer scale — Indonesia is exporting about 18 million cum wood every year, only 5 per cent of the U.S.A.'s industrial roundwood production of 326.5 million cum in 1976. (Table 4).

Table 4: **TOPICAL LOG PRODUCTION COMPARED WITH PRODUCTIVITY OF SOME TEMPERATE FOREST COUNTRIES (1976)**

| COUNTRY | FOREST AREA mha | Production mcum | Production per ha | EXPORTS mcum |
|---|---|---|---|---|
| USA | 202 | 339 | 1.6 | 7.2* |
| AUSTRIA | 3.7 | 8.6 | 2.3 | |
| FRANCE | 13.6 | 27.5 | 2.0 | |
| UK | 1.69 | 1.4 | 0.8 | |
| CHINA | 80 | 75 | 0.94 | |
| JAPAN | 25.3 | 35.5 | 1.4 | 28.9* |
| INDONESIA | 86.5 | 23.0 | 0.26 | 19 |
| SABAH | | 13.0 | | 12.3 |
| SARAWAK | 1.97 | 4.4 | 2.2 | 2.95 |
| PENINSULA MALAYSIA | 5.28 | 9.59 | 1.82 | |
| BRAZIL | 85.0 | 35.6 | 0.42 | |
| GABON | 22.2 | 1.46 | 0.066 | 0.89 |
| GHANA | 2.52 | 1.38 | 0.55 | 0.34 |
| IVORY COAST | 3.0 | 5.65 | 1.88 | 3.275 |
| NIGERIA | 9.6 | 4.6 | 0.48 | 0.93 |
| ZAIRE | 90.0 | 0.59 | 0.007 | 0.05 |

* *Figures quoted are imports of all tropical timber in roundwood equivalent (1973).*

Fig. 10: **SLOW GROWTH IN EXPORTS OF SAWNWOOD (About 80% is kept for the home markets).**

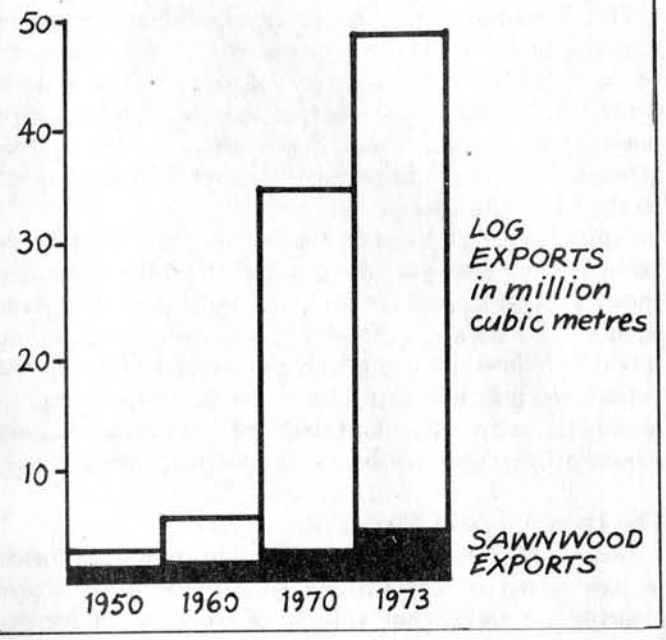
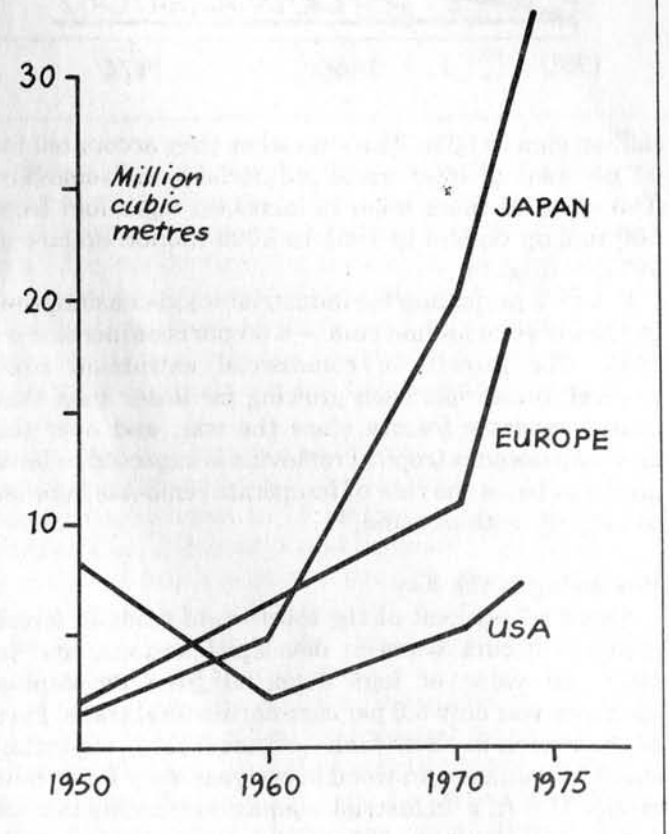



Fig. 11: **JAPAN AND EUROPE ARE THE TWO MAIN IMPORTERS OF TROPICAL TIMBER**




The key factor is the location of processing capacity. Tropical countries have to export raw logs because they have not developed the complex and expensive mills to produce sawn timber, pulp and paper, veneer, plywood, and other wood products which have a much higher value than roundwood. Only 6 per cent of the world's paper making capacity is in the tropics, although they own half of the world's wood.[54] (Fig. 10)

Consequently, tropical countries have to export low value logs to the industrialised nations and then buy back most of their wood product needs. Despite the per capita consumption of paper in developing countries being less than 1 per cent of countries like the U.S.A., up to half the export revenues from logs may be swallowed up by imports of paper.

Japan is the world's largest consumer of tropical hardwoods, (Fig.11) with imports having increased by a factor of 19 between 1950 and 1973, the majority coming from the tropical rain forests of South East Asia. In 1976 Japan could only produce 34.9 per cent of the timber which it needed and is heavily reliant upon imports.

It has a considerable amount of processing capacity, and more than 80 per cent of the U.S.A.'s tropical hardwood imports are processed by Japan into plywood and veneer on the way from the tropical rain forest to the richest nation in the world.

Japan is the world's fourth largest pulp producer but is the only major producer to need substantial imports of pulpwood. In 1975 it was 59 per cent self sufficient but by 1985 this will fall to less than 48 per cent. We usually associate pulp with a softwood raw material but now 57 per cent of Japan's pulp (1970) has a hardwood origin, and the country is leading the way in

the use of mixed tropical light hardwoods such as those from South East Asia. While the quality of paper products from such a starting material is not high, nevertheless about 65 per cent of total production is in the form of lower quality industrial paper such as packaging materials.[55]

The capital requirements for establishing wood producing facilities are very high, and it is in the major commercial centres such as Singapore, Taiwan, and South Korea that such industries have blossomed, the last two now accounting for more than half of Indonesia's log exports.[56] But countries like Indonesia which have extensive timber resources are making strong efforts to increase their processing capacity and so derive a greater share of the value of the end product.

**The Logging Scene in South East Asia**

South East Asia and the Pacific Islands dominate world trade in tropical hardwoods, with more than 77 per cent of trade in 1973 and over 80 per cent expected in 1980. The Philippines, a group of 708 islands with a north-south spread of 1152 miles and an east-west spread of 688 miles, was the first to enter the logging business in a big way. At its peak in the second half of the 1960s some 11 million cubic metres of logs were produced and up to 8.6 million cum exported, but in 1976 this had fallen to 8.6 million cum produced and only 2.3 million cum exported.

Alarmed at the large exports of low value logs, the Philippines announced a few years ago a ban on log exports, but rescinded it at the last moment, preferring a quota system allowing loggers to export 25 per cent of their cut.

After the slump in world trade in 1974-75, the Philippines log exports did not rise as with other countries in the region. One factor was a dramatic rise in domestic consumption, from 17 per cent of total production in 1971-72 to 74 per cent in 1976. Another was growing exhaustion of higher grade logs in the forests.[57]

According to a report published by the Asian Development Bank in April 1979 the cutting of commercial species in the Philippines is exceeding the annual increment,[58] and in September 1978 when India suffered massive floods owing to the denuded Himalayas, the Philippines was having the same kind of experience on the northern island of Luzon. Less than a third of the hillsides have been reforested after logging, and the Ministry of Natural Resources has cracked down on illegal loggers as well as cancelling a large number of logging licenses.[59]

Firewood collection, usually a problem only in forest poor countries, is beginning to worry the Philippines, and extensive plantations of fuelwood trees will have to be established in the near future if the natural forests are to survive. Already national forest cover is down to 38 per cent.[4]

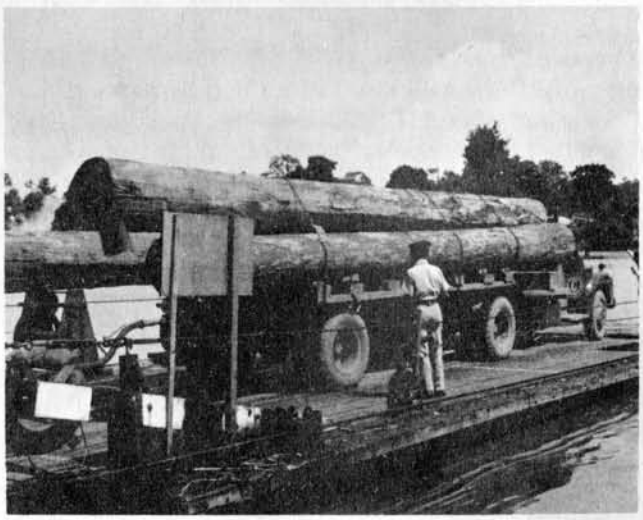
By 1976 exports of sawnwood, plywood and veneer were equal in value to log exports, which had been four times greater as recently as 1974. Plywood is usually the first type of wood panel to be produced when a country establishes a forest products industry, and although the value of plywood exports in 1976 was comparable to that of 1971, the quantity was only half.

Most of the plywood goes to the U.S.A. and Europe, rather than to Japan, which does not like to import anything but unprocessed wood if it can help it. Exports of plywood and veneer for the first three quarters of 1978 were 104 per cent greater than the comparable period in 1977, with the U.S.A. and Japan as the two major customers. However, propects for trade with the U.S.A. look bleak owing to an 8 per cent discriminatory tariff on Philippines mahogany compared with tropical hardwoods from other countries, and new federal laws on the fireproofing of plywood used in mobile homes.[59]

**Malaysia Cuts Back**

Malaysia had overtaken the Philippines in the value of its log exports by 1966, and in all forest product exports by 1970. In 1974 Sabah's exports of forest products had reached 376 million dollars — 27 per cent greater than that of the Philippines.

By 1976 Sabah accounted for 46 per cent of Malaysia's log production, and 80 per cent of her exports, with most going to Japan. But there were widespread recriminations because the ruling United Sabah Organisation party was selling out the state forests, and this led to its downfall in the 1976 elections.[57]



Katherine James

Logs ferried across a river in Peninsular Malaysia.

The Berjaya party, which replaced it, announced a 50 per cent reduction in log exports between 1977 and 1982, and with nearly two thirds of state government revenue in 1977 coming from the 20 to 30 per cent royalties on timber exports, Sabah set to work to encourage the establishment of processing plants to maintain export value.

The first of these, a joint venture woodchipping plant with a Japanese company began operation last year. The Japanese adore woodchips as much as they do rice these days, so Sabah seems to be on to a good thing. Plans for two more sawmills were agreed in 1978.

In 1978 Sabah announced an even greater cut back in export quota which led to Japanese buyers increasing their purchases. A boom in the Japanese

plywood industry and an early start to the rainy season exacerbated the shortages so that by late 1978 prices were rising rapidly. East Kalimantan meranti was selling at 125 dollars per cum, almost double the stable price for the last two years.[56]

This gives Sabah longer to expand its wood processing industry from its present three plywood factories, two veneer mills, a wood moulding plant, and two mangrove woodchipping plants. Peninsular Malaysia accounts for 90 per cent of national sawnwood production, and in its overseas trade not only has to suffer high import tariffs from Australia and the E.E.C. but also competition from South Korea, Taiwan and Singapore — all far more efficient.

At the moment it has an estimated 24 per cent spare processing capacity, and in the spring of 1979 it was revealed that the Malaysian Plywood Manufacturer's Association is negotiating with Sabah to process its logs. This might be a way out of Sabah's difficulties in financing joint venture plants, and in exchange for more integration of timber processing between the states with Sabah foregoing some of its royalties on log exports, the Federal Government might agree to give grants for reforestation. Although there is no import duty on Sabah logs now, Peninsular Malaysia is still faced with high charges for freight as well as for the logs. If an agreement is reached then the shortage of logs for processing outside Malaysia might well start another round of price increases.[60]

**Indonesia's Green Gold**

Officially Indonesia has 120 million hectares of forest covering about 13,000 islands, just less than Malaysia's 138.3 hectares.[61] This figure is the same as was used in the 1960s and since that time logging and encroaching cultivators have caused large areas of forest to be cleared, so it is doubtful whether the forests extend to more than 100 million hectares.[7]

Of more than 3000 species of wood in Indonesia only 107 species are utilised at present. Merantis account for more than half the volume of logs exported, and their wood is not only of a high quality but also floats, making it more desirable to producers and buyers because of easy river transport. Other Dipterocarp woods such as Keruing (*Dipterocarpus spp.*) and Kapur (*Dryobalanops spp.*) are much heavier and in less demand because they are 'sinkers'.[62]

Less than 10 per cent of teak production is exported, because of domestic demand. Other popular woods are Pulai (*Alstonia spp.*) from fresh water swamp forests particularly Ramin (*Gonostylus spp.) and Agathis.* Sumatra's forests contain only half the volume of Dipterocarp wood found on Kalimantan, and its logs are also inferior in quality, commanding a lower price.

**The prime lowland evergreen rain forests of Peninsular Malaysia will probably be exhausted by 1990 and the onslaught on Borneo has already begun.**

While over 90 per cent of Indonesia's logs go direct to other parts of Asia, this is misleading since over 55 per cent of the wood processed by Taiwan and South Korea in 1976 went to the U.S.A., as did a proportion of wood processed in Japan, although most of that went to satisfy domestic demand. The U.S.A. and Japan dominate the world market in logs from South East Asia.

**Exports Take Off**

Log exports took off in 1970 when the volume of 8 million cum was double that of the preceding year. By 1973 the figure was 18.7, and while the volume was 5 times the 1969 level, the value of 562 million dollars represented a nineteen fold increase. The Government intends to maintain the export quota at 18 million cum.

Forest products exports, which in 1974 were nearly two and a half times those of the Philippines and almost equal to those of the whole of Malaysia, had risen to 830 million dollars in 1976, 1000 million dollars in 1978, with 1,400 billion dollars forecast for 1979.[63]

Revenues from timber exports are about 10 per cent of Indonesia's annual foreign exchange earnings which are dominated by those from oil (70 per cent) although timber brings in more than rubber and coffee combined.[62]

While relying upon foreign capital to fund forest exploitation, Indonesia only allows overseas companies to participate in the timber industry on a joint venture basis or as contractors to concession holders. Another condition written into concession agreements is that within 10 years of the start of extraction, 60 per cent of the timber must be processed domestically. While excellent in theory, this is very often difficult in practice for those whose concessions are right in the middle of Kalimantan with meagre transport to and from possible mills. In 1977 twenty companies lost all or part of their concessions for failing to fulfil their processing commitments.[57]

**Processing Increases**

Between 1970 and 1975 Indonesia trebled the volume of wood converted into sawn timber from 800,000 cum to 2.4 million cum. By 1979 this had almost doubled to 4.5 million cum, with 1.5 million cum of exports, scheduled to rise in 1983/84 to 4 million cum.

in 1976 the 68 sawmills were still only working at half capacity, and only 0.2 million cum of plywood was being produced by 12 mills with a combined capacity of 1 million cum. Despite this, sawmill capacity is expected to increase to 6.38 million cum in 1981 and plywood/veneer capacity to 1.76 million cum. Fifteen additional sawmills and 2 plywood mills have been approved already, but costs are high. An Indonesian plywood plant may cost 5 million dollars, or twice the cost of a comparable plant in Taiwan or Singapore.

The low exports of ramin logs are partly due to restrictions introduced to protect local sawmillers. Ramin accounts for over 75 per cent of sawn timber exports (1977) since it was already established as a

market favourite in other countries of the region when Indonesia's forest industry started to expand in the late 1960s. Meranti's share is climbing slowly.[62]

Export of Indonesian sawn timber is inhibited by protective tariff barriers as well as difficulties with grading standards. It is interesting to see that about half of these exports come to Europe, with Italy taking a giant share (249,598 cum) and the United Kingdom next with 27,545 cum. While that might seem a small volume it is still a debit of nearly 2.5 million dollars on the U.K. balance of payments.

**It is hard to lay the blame for deforestation at the feet of any one group. The only thing we can be certain about is that the forest is disappearing and when it goes everyone will suffer.**



**Logging in the Amazon**

Brazil produces more wood than any other tropical country, a third more than the whole of Malaysia and half as much again as Indonesia. It bans the export of logs and despite turning out three times as much sawn timber as Indonesia in 1978, it exported only 4 per cent of the total (one third of Indonesia's exports) because of large domestic demand.

The country's substantial timber industry has been built upon exploitation of dense stands of Parana pine (*Araucaria angustifolia*) and forest cover of the southern state of Parana (20,120,300 hectares in size) has been reduced fron an original 84 per cent to a mere 8 per cent in 1978.

The Brazilian Government has since 1966 spent about 1.7 billion dollars establishing 2.6 million hectares of fast growing pine and eucalypt plantations of which about one fifth are in Parana. Fuelwood accounts for 80 per cent of national wood production, both in homes and in the expanding steel industry. The use of fuelwood to contribute a quarter of all energy consumed in Brazil results in an import saving of 2 billion dollars a year, and so with an expanding economy *and* crippling oil import bill, Brazil had a great incentive to become the world's number one country in afforestation.[64]

While the Amazon rain forest covers 41 per cent of the whole country and represents 82 per cent of all Brazilian dense forests, it contributes only about 10 per cent of national production of industrial roundwood and 29 per cent of exported sawn timber, with a total investment by timber companies of some 15 million dollars. Yet the wood standing in the Amazon rain forests, each day a little being burnt

down for one or more ranching projects, is valued at between 500 and 1000 *billion* dollars, and Brazil is trying to solve the problem of just what to do with this vast resource.[65]

**Extraction Difficulties**

Most harvesting of Amazon timber at the moment is carried out on a small scale by river dwellers acting in conjunction with local agents, and the low costs of this traditional industry, based on easy river transport of logs cut from the flooded *varzea*, would make the highly capital intensive operations of big foreign timber companies highly unprofitable. They would have to fell trees in the terra firme forests and then haul the logs for long distances by road before reaching the nearest river.

The Amazon rainy season lasts for about six months from January to June and during this time not only is logging impractical but even 'main' highways like the TransAmazonian are impassable in places because of flooding. Sometimes extraction of trees has to be limited to a one month period, and this does not make operations very economic. With the river as the only practicable transport medium the fact that a large number of Amazon species are too heavy to float is not very helpful either.[66]

**Few Commercial Species**

But the major difficulty which timber companies face is that most of the species in the Amazon forests are not marketable in Brazil let alone internationally. At the moment production is dominated by virola (*Virola spp.*) (38 per cent), Brazilian mahogany (*Swietena macrophyla*) (8.7 per cent), crabwood (*Carapa guianensis*) (6.5 per cent), louro (*Ocotea cymbarum*) (6.4 per cent), and red cedar (*Cedrela odorata*)(4.6 per cent). Of the 46 per cent of production which is exported, virola, crabwood and Brazilian mahogany account for 83 per cent of export volume. The five species listed above represent 58 per cent of timber on the local market.[2]

A recent survey of 57,000 hectares of forest at Alto Purus in the upper Amazon found 391 species of which most had small diameters. Of the total volume of 12 million cum for trees greater than 45 centimetre diameter, 5.5 million cum was of 47 known species and 38 species had more than 10,000 cum each. Eleven commercially (locally) well known species had a share of more than a third of this total volume.[66]

The challenge of utilising the timber once it is cut, combined with heavy costs of harvesting and transport, do put great obstacles in the path of any large scale logging operation in the Amazon. An announcement in January 1979 that the Brazilian Government was going to sell concessions to log 39 million hectares of rain forest was greeted by such a storm of public protest that the plan had to be shelved. With the inauguration of the new Government under President Joao Figueiredo it became politically more unlikely. Yet even politics cannot overcome severe economic handicaps especially when they involve both local costs *and* international market forces.[67]

**Future Options**

Brazil seems to have three options at the moment. The first is just to wait and see. The value of Amazon timber is bound to rise as other tropical hardwood reserves become exhausted. Two things militate against this possibility — Brazil's need to expand quickly to satisfy both the aspirations of its people and the reminding letters from its creditors, but added to this is its questionable ability to protect national forest wealth from clearance for agricultural or other settlement schemes.

The second option would be large scale forest clearance. The one way of felling the forest economically at present would be to extract commercial species for processing and at the same time convert the remainder by distillation into charcoal for the steel works, methanol for its rapidly rising car population, or into feedstock for chemical works. With the current climate of public opinion in Brazil this would be politically hazardous, but also the economics of transporting even charcoal for long distances to steelworks might not be so advantageous as some might claim. Nevertheless, the Ministry of Agriculture has produced a feasibility study for the production of charcoal from Amazon forests which envisages an annual cut of 2,000 hectares from a 100,000 hectare forest with a rotation period of 50 years in order to produce 50,000 tons of pig iron a year. The study concerned does seem to be optimistic about the possibility that the forest will regenerate. South East Asian countries have a reasonably good market for their timber yet only now are they coming face to face with difficulties of regeneration, and they are years in front of Brazil.[68]

The third option involves a much more measured approach. The large hydroelectric scheme at Tucuri will require the clearance, between now and 1983, of 216,000 hectares of rain forest. Transport problems won't be too major because of proximity to the Tocantins and Amazon rivers. Already fourteen timber companies have put in tenders for logging contracts, in which one of the conditions will be that processing takes place before export of the wood (as current regulations require). About 30 large saw mills will be needed with an estimated annual input of 45 million cum over the three years before the area is flooded. This project by virtue of its sheer size, could lead to greater acceptance of Amazon timber on the world market, whether as sawnwood, plywood or veneers, or in the form of furniture produced domestically.[69]

**Nearly half of all the timber cut in the world is used for fuel. In the developing countries of the tropics, it is the stable energy source for 90 per cent of the population.**

**Africa — Smaller Scale**

Logging in Africa is on a much smaller scale than in Asia. In 1980 it is expected to account for 13 per cent of tropical hardwood production and 15 per cent of exports. Seven countries — Cameroon, Congo, Gabon, Ghana, Ivory Coast, Liberia and Nigeria are responsible for over 90 per cent of Africa's log exports with 44 per cent coming from just one country — the Ivory Coast. Yet log exports from the Philippines, Malaysia and Indonesia combined are seven times greater than those from the whole of Africa. (Fig. 12).

While the Ivory Coast exports more logs than anybody else, Gabon's logs are more valuable and so it exceeds the Ivory Coast in dollars earned. In 1975 both countries were exporting in the region of 200 million dollars worth of forest products.

This is very much a period of transition for African forestry. Nigeria's log exports have plummeted as domestic demand has taken an increasing share of production. The rate of increase of production has not been sufficient to keep up with the growth in demand and Nigeria has been a net importer of forest products since 1976.[70]

As West African forest resources diminish, countries like Liberia will gain ascendancy for a time and other nations will seek to maintain earnings from their timber industry by establishing plantations and increasing their processing capacity. They will also seek acceptance for lesser known species on the world market.

The Ivory Coast already has an export quota for logs to protect the home processing industry, which in 1977 employed about 2600 people with an investment of 37,500 million CFA francs.[71] Two new processing complexes are being built in the west of the country, each costing 4,000 million CFA francs. Sawmills are being expanded: a typical example is the SCIFI mill which received a 180 million CFA franc loan in 1979 for this purpose. A new pulp mill is proposed in San Pedro, and it is expected to be producing 300,000 tons of pulp a year starting in 1982.[72]

The World Bank, Commonwealth Development Corporation, and Ivory Coast Government announced in mid-1979 the start of a 39.4 million dollar project to establish timber plantations of hardwoods such as Cedrela and the indigenous Frake and Samba. 20,000 hectares of previously logged forest will be cleared and revenues of 350 million dollars are expected over 30 years. The plantations will be taking over from the natural forests as the main input to the nation's wood processing industry.[73]

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**"There is no documented case of a logged Dipterocarp forest actually reverting to its original climax state".**
**Dr.Norman Meyers.**

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## Logging Systems in Question

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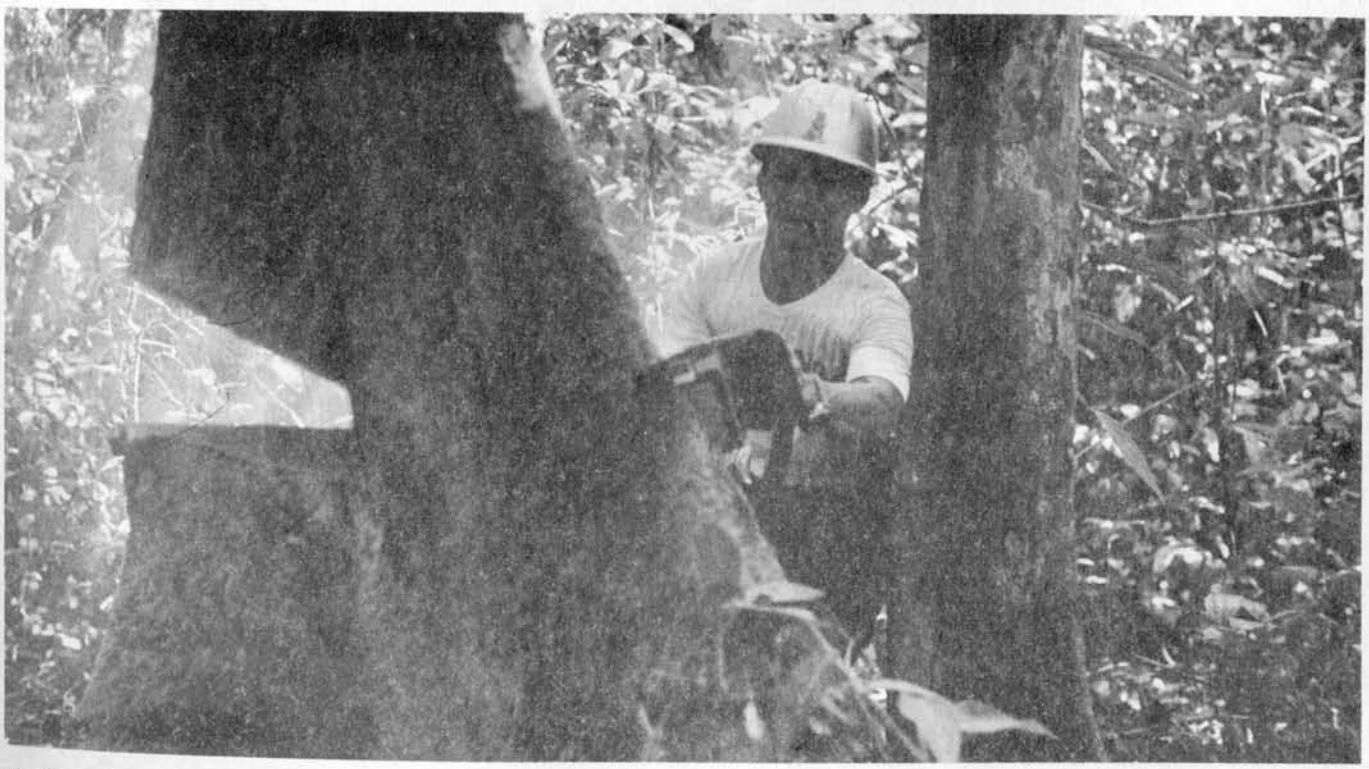
The process by which the highest quality logs of the relatively few commercial species are extracted is called 'creaming'. The Selective Felling System places this on a long term basis by defining the minimum size of tree which can be cut, and the minimum number of



R. Hanbury-Tenison

## TROPICAL DEFORESTATION — NATIONAL ESTIMATES

**CRITICAL**

Thailand
Philippines
Peninsular Malaysia
India
Queensland (Australia)
Ghana
Nigeria
Panama
Guatemala
West Indies
Ivory Coast

**ENDEMIC**

Sabah
Sarawak
Sumatra
Kalimantan (Indonesian Borneo)
Brazil
Venezuela
Mexico
Honduras

**DEVELOPING**

Irian Jaya
Papua New Guinea
Sierra Leone
Liberia
Congo (Brazzaville)
Zaire
Gabon
Peru
Colombia
Ecuador
Cameroon

**KEY**

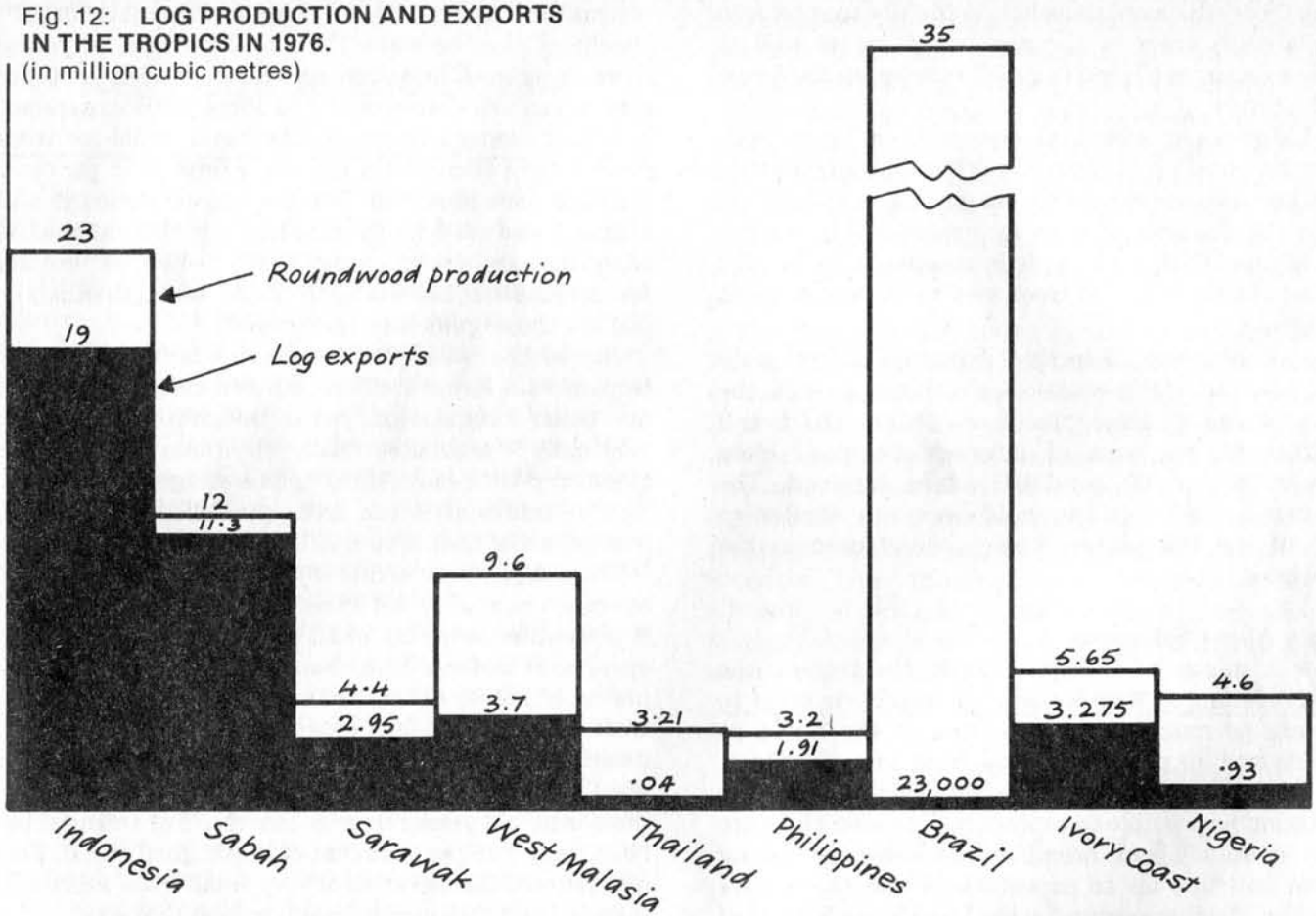
**Critical:** lowland forests mostly gone, hill forests now under attack or dwindling, biological maintenance breaking down. Life 10 years at most.

**Endemic:** shifting cultivation and logging in full swing. Life 15-20 years on average.

**Developing:** logging only just/not yet started, shifting cultivation not yet a problem.

**DEFORESTATION HAS REACHED SERIOUS LEVELS IN SEVENTEEN COUNTRIES.**

Fig. 12: **LOG PRODUCTION AND EXPORTS IN THE TROPICS IN 1976.**
(in million cubic metres)




Jackman

young trees which are to be left on the site to grow into merchantable trees in the next rotation, as well as acting as sources of seed that will regenerate the forest for the future.

In Indonesia at least 25 trees over 35 cm diameter at breast height (D.B.H.) must be left well spaced out in every hectare, and the minimum cutting limit is 50 cm DBH. The majority of trees for export will be greater than 60 cm DBH anyway. It is assumed that by this method the next crop of trees may be harvested in 35 years time.

The Philippines Selective System differs only slightly in having a rotation of 30 years, with the minimum felling limit placed at 60 cm DBH and requiring 60 per cent of intermediate sized trees between 20 and 60 cm DBH to be retained. The Malayan selective felling guidelines are similar to those of the Philippines, being mainly used in the hillforests.[73]

**Doubts About Selection**

Now it might be thought that in the tropics, the selective felling system is the most suitable in order to (i) retain as much of the structure of the forest as possible and (ii) protect the soil from excessive heat, rain, and consequent erosion by leaving as much vegetation as possible to protect it. However there are grave doubts about whether the selective felling system will live up to expectations and these were voiced by The Symposium on the Long Term Effects of Logging in South East Asia in 1975. Thailand is replacing selective felling with clear felling because the latter does not seem to allow sufficient regrowth in the forest of desirable species. Indonesia and the Philippines are both investigating the matter very seriously at the moment.[73]

In the opinion of Dr Peter Ashton, Curator of Boston's Arnold Arboretum "The present meagre evidence confirms that present exploitation rates cannot be maintained; it suggests too that selection systems of management will generally prove less productive than uniform systems, and that the 30-35 year felling cycles frequently advocated will prove unattainable." He criticises "the hopelessly inadequate data base that presently exists for developing and managing most Mixed Dipterocarp Forests." His fundamental criticism of selection systems is that they must by their very nature lead to decreasing yields because the trees to be felled on the second rotation will have experienced highest mortality before the first felling.[47]

**Logging Damage**

Another objection is that during and after felling a considerable number of the young trees will die as a direct result of the interference in the forest. Sastrapradja, Kartinawata et al quote surveys which show that as much as 50 per cent of the residual stand may be damaged, and the surface soil may be destroyed when up to 30 per cent of the ground surface is exposed. According to them it will take more than 40 years for such a disturbed forest to recover, and this is longer than the desired rotation cycle.[73]

Another study, by Setyono Sastrosumarto[74] concludes that between 17 and 50 per cent of young trees experience fatal damage; between 16 and 50 per cent of trees of diameters 20 to 50cm DBH experience non-fatal damage to crown and bark, while for trees greater than 50cm DBH the upper limit is 55 per cent. He finds that providing the stocking of seedlings and saplings was sufficient before logging, there should be adequate numbers of young trees on which to base the second rotation, according to the present guidelines — but are those guidelines sufficient?

Part of the reason for the damage is that trees in a tropical rain forest are both tall and closely connected by other vegetation with neighbouring trees. Whitmore[9] estimates that the area of damage associated with *each* felling is on average 0.04 hectare. This means that if ten trees are felled per hectare, nearly half of that area will be affected.

These figures are in line with Ashton's estimates: an average mortality of one third of the original regeneration owing to forest destroyed during logging operations and soil disturbance which can be up to 50 per cent in steep areas, and another third of the young trees lost as a long term result of the non-fatal damage mentioned above. If there is to be the same number of good sized trees when it is time for the second rotation the density of young trees before the first felling must be at least 225 per cent that of the original stand. This necessitates the inclusion of very small trees which will take at least 40 years to reach exploitable size.

There is also the possibility that logging, by interfering with the internal dynamics of the forest, can change its species composition. The pioneer species which colonise cleared areas exposed to sunlight could dominate the composition of the stand so that it could take a long time to revert to a climax forest as was the case before logging.[74] There is no documented case of a logged Dipterocarp forest actually reverting to its original climax state.[7]

So it seems that even if Government guidelines were to be followed to the letter, the forest would be unlikely to fully regenerate in the time prescribed and there would be a gradual decline in productivity rather than sustained yield. But are the rules being kept by the loggers?

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**"All that we know about plants has been handed down to us by primitive peoples. We have produced nothing in spite of our ingenuity. The potato was being grown by Indians in a small place in the Andes but it helped to launch the most impressive civilization the world has seen."**
**Dr.Conrad Gorinsky.**

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## Real Life in the Forest

Someone with first hand experience of logging in the region is a UNDP forester, S. Andel, who states quite emphatically that:

"Until recently, exploitation companies have not shown any responsibility in efforts towards maintaining and realising productivity potentials of the resource base for the future. Big businesses have hitherto managed to get away with paying lip service to any form of longer term forest management."[75]

Sastrapradja and Kartinawata et al are of the same opinion: "In practice....only a small proportion of concession holders actually follow the regulations in spite of the fact that sanctions have been raised against the concession holding rights."[73]

Anthony Rowley, writing in the *Far Eastern Economic Review* states "While no law required the loggers to replant or avoid damage to saplings, they were certainly not voluntarily going to exercise such restraint and rehabilitate the forests. Their more pressing need was to get the prime logs out of the forests and off to the sawmills or ships. According to the *Ministry of Finance Annual Economic Review* published last month: "Selective logging has resulted in the wasteful exploitation of timber resources (to the point) where the average annual rate of harvesting over the past decade is around 500,000 acres, compared with potential productive forests of 9.3 million acres in Peninsular Malaysia."

Loggers often take more logs than they are entitled to, and bribe their way past the government checking points. As one local man said in Malaysia: "There is a lot of hanky panky going on ... The (forest) rangers earn less than 300 Malaysian dollars a month and yet some of them run big cars. Where is the money coming from?"[57]

So one way or another, and there are many ways of beating the system, more trees are being extracted than are permitted by the concession conditions. From what we have seen above, even these conditions do not make us confident that that forest will be regenerated.

The logging pattern laid out in the concession agreement might not even be workable. A study of nine companies working in the forests of East Kalimantan found that not one was leaving the specified number of trees behind for the second rotation[76] but that in most cases it was doubtful whether there were sufficient trees there in the first place. Another study has concluded that if the logging companies did keep to the conditions they would not make a profit.[77]

The last point must be emphasised — concessionaires are obeying the laws of the jungle and connot be certain that poachers will not fell and remove the high grade trees before the logging team can get into action.

When roads are constructed into the forest and certain clearings have been made, shifting cultivators can come onto the scene pretty quickly and burn down portions of the forest to grow crops. With things as they are, no logging company could reasonably invest in regenerating the area it has logged and be confident that even at the end of 30 years there would be a forest left to log again. Generally there is poor protection of the forest by the Government and the forest service. The regeneration could well be eliminated if the forest were to be harvested before the next rotation was due.[47]

The picture is not a very optimistic one: unless the forests can be protected and the cost of proper forestry operations and investment assured, loggers are going to continue to behave just as they do at the moment, going in to grab as much as they can and leave as soon as possible. Because of the temporary glut of tropical hardwood, prices are relatively low and make both protection and reforestation uneconomic. There is no incentive (or funding) to develop sustainable silvicultural systems to replace the present selective felling systems in which, outside government circles, there is little confidence.

## IF THE FORESTS SHOULD GO

**The Cultural Consequences of Deforestation**

By brawn and brain, the small ape which left its home in the African forests some 14 million years ago and developed into Homo sapiens only 100,000 years ago, has become the dominant animal on Planet Earth.

Yet we have lost the communal awareness that our destiny is closely linked with the survival of the millions of other living things on this planet. They have provided the basis for everything we do today and it is unlikely that we could ever replace by machines their crucial roles in the maintenance of the biosphere.

Perhaps there is a sub-conscious desire to renounce our forest and animal origins, or even to destroy the forest just because it has developed by purely natural means to a state of complexity that we could never hope to imitate. Whatever the reason, let us be quite certain that the destruction of the tropical rain forests will have profound effects on human culture, for we are inextricably linked to the forest which, in the words of a French forester, "is part of the soul of man although we may not be aware of it."[78]

We are giving the kiss of death to our relatives, the other primates who stayed in the forests and whose whole existence is bound up with their sylvan habitat. Threatened also are the many tribes of hunter gatherers who maintain the contact with the forest upon which we have reneged and often fail to comprehend the futility of our so called civilisation.

Should the forests disappear, something of us will vanish as well. Part of this will be as indefinable as the innocence lost by a child on becoming an adult, while

R. Hanbury-Tenison

another part will be as hurtful as the loss of close relatives. Natural wilderness, defined by Sir Frank Fraser Darling[79] as "a factor for world stability, an active agent in maintaining a habitable world" is vanishing, and our concern should not be purely sentimental.

## Forest Dwellers — the Missing Link

There are about 200 million people living within or on the margins of forests, relying upon them not just for food and firewood but for raw materials with which to make clothes, buildings and medicines.[7] Of these, about 1 million are hunter gatherers, and while they might be regarded by some as among the most primitive peoples in the world, their detailed knowledge of the forests in which they live is increasingly acknowledged and respected by scientists.[6]

Dr Conrad Gorinsky is a biochemist on the research staff of St Bartholomew's Hospital Medical School in London: "The idea of consulting witch doctors is completely offensive to many scientists. I don't find it so in my work. At the moment I am constructing a molecular model of a drug which may be capable of treating mental illness. It would never have been discovered without primitive man telling me about it, and me translating it into something practicable."

"All that we know about plants has been handed to us by primitive peoples," says Gorinsky. "We have produced nothing in spite of our ingenuity. Take the potato. It was being grown by Indians in a small place in the Andes. From this a bigger and better potato was bred. One could say that the Industrial Revolution was made possible by the potato's intensive foodbase. That pathetic group of Indians, now forgotten, in fact helped to launch the most impressive civilisation the world has seen."

At a time when we are just beginning to realise how little we know about the wonders of the Amazon rain forest, the Amazonian Research Institute in Brazil has a staff of only 50 scientists working on all aspects of the problem, compared with the 1500 actually needed. The Indians of the Amazon hold in their culture a large part of the knowledge which we are seeking, yet they face extinction.

## Indians of the Amazon

The most recent list of hunter gatherers is given in Table 6. It[6] omits aboriginal peoples who are settled or semi-settled cultivators, and whose culture may still be closely linked with the nearby forest. The Yamomamo are included because they are hunter-gatherers as well as slash-and-burn shifting cultivators, and this is not unusual. Their type of cultivation, using as it does a large diversity of species and varieties, is closely integrated with the natural forest.

They represent the largest almost entirely isolated group amongst the Brazilian Amazon's 140,000 Indians, with a population of some 8,500 not counting a slightly larger number on the other side of the border in Venezuela. When Europeans first arrived in Brazil in 1500 the Indian population was of the order of one million.

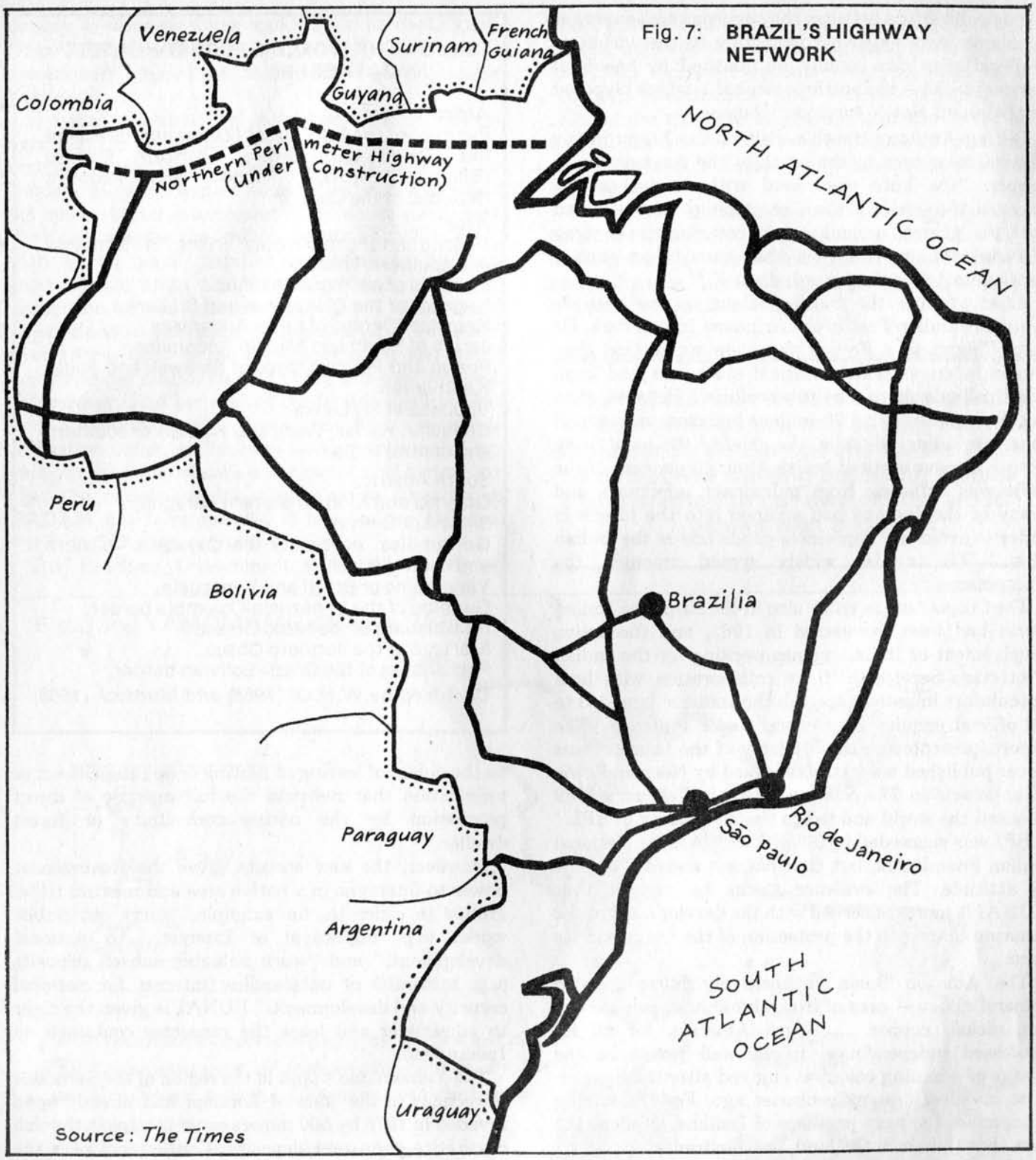



Fig. 7: **BRAZIL'S HIGHWAY NETWORK**

Should it ever be completed, Brazil's 14,000 kilometre network of highways (including the infamous 5,500 kilometre TransAmazonian Highway 230) will bisect more than half the 171 tribal areas.[80] The Yamomamo are affected by the Northern Perimeter Highway 210, which will eventually cut across their territory for 600 kilometres. Since 1973, when the construction teams first entered Yamomamo territory, the story has been one that typifies the encounter between primitive man and his civilised counterparts in the Amazon Basin.

*Survival International Review* estimates that by 1974, 13 villages along the first 100 kilometre stretch of highway were 'practically decimated' after contact with the construction teams whose members were not screened for ill-health before recruitment. In another region two measles epidemics in three years killed nearly 80 Yamomamo, about 50 per cent of the population. African river blindness (onchoceriasis) was unknown in the region until 1973, and now between 25 and 62 per cent of some groups are affected.[81]

Ever since the Spanish and Portuguese first colonised Latin America in the 16th Century the indigenous peoples have been subdued as much by introduced diseases as by the barrel of the gun. It makes current debates about the 'possibility' of

biological warfare between the superpowers somewhat academic. Any lingering opposition to the wishes of civilised man can usually be quashed by the final master stroke — the bottle of alcohol — which disposed of the proud North American Indians.

During Anthony Smith's visit to the Xingu in the Mato Grosso area to the south of the Amazon Basin proper: "the huts were loud with fearful coughs because the whole Indian community was afflicted with the 'grippe', a blanket term covering all the virus diseases akin to influenza that have taken such a continental toll of the Amer-Indians." [82]

After visiting the Surui Indians at the Sete de Setembro Indian Post in the Aripuana Indian Park, Dr Jean Chiappino, a French physician stated that they "were in an extremely critical state and had been practically decimated by tuberculosis." Between June and November 1972: "20 Indians had died, and several more, including Dikboba, the chief of the band, were now in a grave state of health. Over 40 per cent of the tribe was suffering from pulmonary infections, and many of the Indians had escaped into the jungle in order to avoid the oppressive conditions at the Indian Post." TB is also widely spread amongst the Yamomamo.[83]

The Cintas Largas tribe, also in the Aripuana Indian Park, had been massacred in 1963, and the active involvement of Indian agents working for the Indian Protection Service (SPI), in collaboration with land speculators impatient to grab the Indians' land, led to an official enquiry by General Jader Figeiredo. The report, presented to the Ministry of the Interior, was never published but extracts leaked by Norman Lewis in an article in *The Sunday Times* in February 1969 shocked the world and led to the disbanding of SPI.

SPI was succeeded in 1968 by FUNAI, the National Indian Foundation, but that has not meant a change of attitude. The evidence seems to suggest that FUNAI is more concerned with the development of the Amazon than with the protection of the Indians in its care.

The Amazon Basin is positively bursting with mineral riches — ores of iron, aluminium, manganese, tin, nickel, copper .... South America, for all its professed independence, might well revert to the status of a mining colony it enjoyed after the Spanish first invaded it many centuries ago. For the mining companies, the mere presence of Indians, let alone the fact that they own the land, is a hindrance.

After the Aripuana Indian Park was created in 1968, specifically for the protection of the remaining members of the Cintas Largas and Surui tribes, FUNAI and other agencies of the Brazilian Government gave the go ahead for mining companies to carry out surveys in the Park. They and other settlers brought in diseases and their presence caused the Indians to react violently. Despite protests by the Director of the Park FUNAI would not order the invaders to leave.[83]

After these incidents a new national Indian Statute was passed by the Brazilian Government, recognising the exclusive rights of Indian communities to territories and lands, stating that "native land cannot be the object of leasing or renting or any judicial act or negotiation that restricts the full exercise of direct possession by the native community or forest dweller."

Table 5 **THE WORLD'S FOREST HUNTER GATHERERS**

*Africa*
Pygmies of the Ituri forest (Zaire) and forests of the Cameroon, Central African Empire (Babinga, Bi-Aka), Gabon and People's Republic of the Congo.

*Asia*
Negrito and proto-malay tribes of Malaysia and southern Thailand.
Yumbris of northern Thailand.
Negritos of the Philippines and Sri Lanka.
Negritos (Onges) of Little Andamans.
Jarain of South and Middle Andamans.
Punan and Penan groups of Sarawak and South Kalimantan.
Veddahs of Sri Lanka.
Chenchu, Kadar, Warli and Katkari of southern and central India.

*South America*
Guayaki and Moro of eastern Paraguay.
Siriono of Bolivia.
Ge families, especially the Cayapo of eastern and central Brazil.
Yanomamo of Brazil and Venezuela.
Guahibo of the Venezuela-Colombia border.
Nambikuara of the Mato Grosso.
Mortoko of the northern Chaco.
Pakasnovas of the Brazil-Bolivian border.

*Compiled by W.H.O. (1968) and Murdock (1968)*

However, the new statute gives the Government power to intervene in a native area and relocate tribal groups in order to, for example, "carry out public works (e.g. highways) of interest to national development," and "work valuable subsoil deposits (e.g. minerals) of outstanding interest for national security and development." FUNAI is given the right to administer and lease the resources contained on Indian land.

The Yamomamo's land in the region of the Serra dos Surucucus in the state of Roraima had already been invaded in 1975 by 500 miners eager to exploit the rich cassiterite (iron ore) deposits. Conflict between the miners and the Indians eventually caused the Brazilian Government to take action to kick them out.

A few years later FUNAI, after an aerial survey, pronounced 21 small and discontinuous areas in Roraima and Amazonas states to be "areas of Yamomamo Indian occupation". But instead of protecting the Indians, these plans are a recipe for their destruction, as well as a passport to big international mining companies to exploit the area's cassiterite deposits.

The small pockets of land will be too small to allow the Yamomamo to continue traditional agricultural practises, restrict inter-village relations leading to a fragmentation of their culture, and open up Indian

society to diseases which could sound its death knell. Some 2,000 Yamomamo — 24 per cent of the total — are actually ignored by the proposal and will become landless.

Survival International has launched an urgent campaign to persuade the Brazilian Government to emulate Venezuela's enlightened treatment of its Yamomamo and create a single Park with an area of 6.4 million hectares to protect them in accordance with their rights under the Indian Statute. (Fig. 13).

In a 40 page detailed programme, Survival International state that[84] such a large area is in proportion to the Yamomamo's share of the local population. In the state of Roraima they represent over 13 per cent of the total population and would occupy 18 per cent of its area under this new proposal.

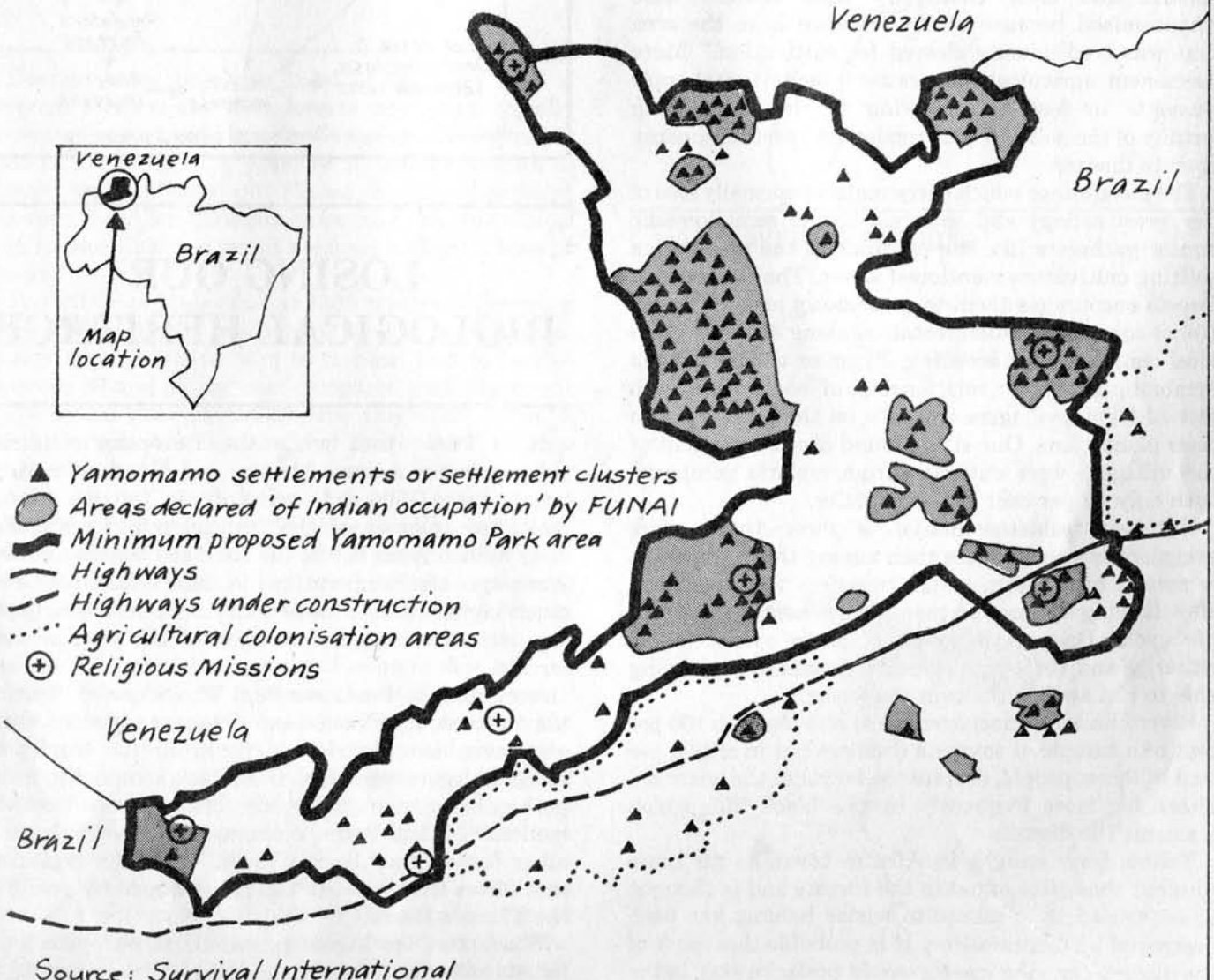
Moreover, 33.5 per cent of the land is mountainous and is permanently protected from economic utilisation under the Forestry Code. Another 40.5 per cent of the land is of such a low quality for agriculture that the national aerial reconnaisance organisation RADAM has recommended it be used for National Parks and Ecological Stations.

The Brazilian Government is rightly concerned about the development of its natural resources but this should not and need not flagrantly over-ride the territorial rights of Indians given to them in the national Constitution and related statutes. The Indians are the natural guardians of the forest and natural resources — if it were not for their opposition, the tin ores of Roraima would have been plundered long ago.

The Indians should be respected for their enshrined forest values and for their knowledge of the forest, the development of whose biological resources could be undertaken far more rapidly in partnership with the Indians than in their absence.

**The tropical rain forests are the world's richest gene banks, and as they start to disappear so do our options for the future. It is just like walking out along a plank and starting to cut away at the wood behind with a saw.**

Fig. 13: **YAMOMAMO INDIAN PARK**



# Health, Disease and Settlement

The settlement of primitive peoples away from their forest home not only brings them into continuous contact with western infectious diseases, but to local diseases from which they were protected by their forest lifestyle.[6]

Pygmies from the Congo have become ill from drinking water in the villages rather than from pure forest streams, and are even affected adversely by exposure to sunlight. Orang Asli in Peninsular Malaysia have a low blood pressure and an absence of cardiovascular diseases when they live in the forest, but one group suffered a tenfold increase in hypertension when it was resettled in a rubber plantation.

The UNESCO report quotes an example in which "Melanesian swidden (shifting) cultivators converted to Christianity by missionaries who resettled them in coastal villages near to the church were destroyed by malaria and their customary food sources were compromised because of the distance from the area that was traditionally cleared for cultivation." More permanent agriculture can cause a lack of vital trace elements in food crops owing to the diminishing fertility of the soil and thus render the resettled people open to disease.

The mosquitoes which carry malaria normally live in the forest canopy and so rarely bother semi-nomadic hunter gatherers like the pygmies or the melanesian shifting cultivators mentioned above. The clearance of forests encourages them to come down and feed upon *Homo sapiens*, and deforestation along streams gives ideal conditions for breeding. Pygmies usually have a symbiotic economic relationship of some kind with settled Bantu villagers who live on the produce from their plantations. One study found that 50 per cent of the villagers were suffering from malaria compared with only 12 per cent of the pygmies.

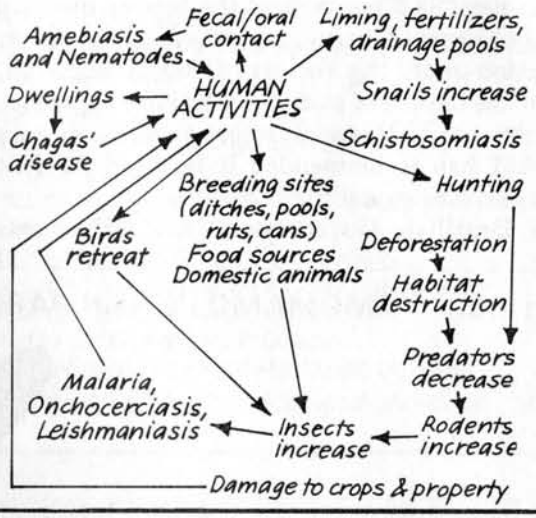
Bilharzia (schistosomiasis) is three times more prevalent in the villagers than among the pygmies. It is spread by a worm which transfers from snails in slow flowing streams to man for the next stage of its life cycle. One of the most common symptoms is lethargy and the pygmies pride themselves on being able to run swiftly through the forest.

River blindness (onchocerciasis) was found in 100 per cent of a sample of savanna dwellers but in only 5 per cent of forest people, despite the fact that the latter are bitten far more frequently by the black flies which transmit the disease.

Yellow fever caught in African towns is far more virulent than that found in the forests and is thought to be caused by a mosquito whose habitat has been destroyed by deforestation. It is probable that most of the disease carrying insects would prefer to stay in the forest canopy and feed upon animals rather than on man. There is a special type of malaria confined exclusively to non-human primates. If we destroy the forest and the mosquitoes start to feed upon *us* because the primates have disappeared, a whole new disease could be launched upon the international scene. (Fig. 14).

The medical implications of tropical deforestation are not as insignificant as the lack of attention paid to them implies. If even *local* people can be severely affected when exposed to disease carrying insects that were previously happy to stay in the forest canopy, it does not augur well for the rest of us.[85]

Fig. 14: **RELATIONSHIP BETWEEN ENVIRONMENTAL MODIFICATION AND DISEASE.**




# LOSING OUR BIOLOGICAL HERITAGE

It is ironic that while the European countries colonised the Asian, African and South American tropics from 1500 A.D. onwards, in fact we are the biological colonies of the tropical rain forests. For sixty million years before the Ice Ages began a million years ago, the temperatures in middle latitudes were much higher than those of today, and accordingly the vegetation was similar to that of the tropical rain forests.

According to Professor Paul W. Richards: "During the Cretaceous, Eocene and Oligocane periods there was, even in countries as far from the tropics as Britain, vegetation which in floristic composition, and perhaps also in physiognomy, closely resembled the modern Tropical Rain Forest, as the London clay and other fossil floras bear witness."[86] Pollen typical of rain forest flora has been found in Eocene deposits in the Thames Basin.[5]

When the Ice Ages appeared, the tropical rain forests withdrew, leaving us with mere remnants of their biological wealth. Many temperate plant species

and genera of today are therefore adaptations of tropical plants to our more extreme climates. The relatives of our well known trees may still be seen in the forests of the humid tropics.[87]

The Ice Ages brought a drier climate to the tropics, causing great reductions in their extent, except in South East Asia (the wettest region of all) in which conditions were ameliorated by the seas surrounding them on all sides and the mountains which gave flexibility to the distribution of vegetation. Substantial parts of the Amazon Basin rain forest became savanna grassland as the forest retreated to 16 refuges (see Figure 15) which still today are centres of great plant diversity and abundance needing urgent conservation measures.[88]

Africa was always a dry continent, but its flora was definitely impoverished by the Ice Ages, having been much richer in species as well as extending to a greater area than today. Four main areas of forest remained to serve as a base for the expansion which took place only 12,000 years ago (see Figure 16). These refuges also demand much greater attention in conservation planning.[14]

## Tropical Treasure Houses

Despite being only one third of the total area of tropical forests, the rain forests are quite literally treasure houses, and the role of man at the moment is that of a looter. Of a possible 10 million species of plants and animals on Planet Earth somewhere between 2 and 5 million are to be found in the tropical rain forests. It is the world's richest biological zone or biome.[14]

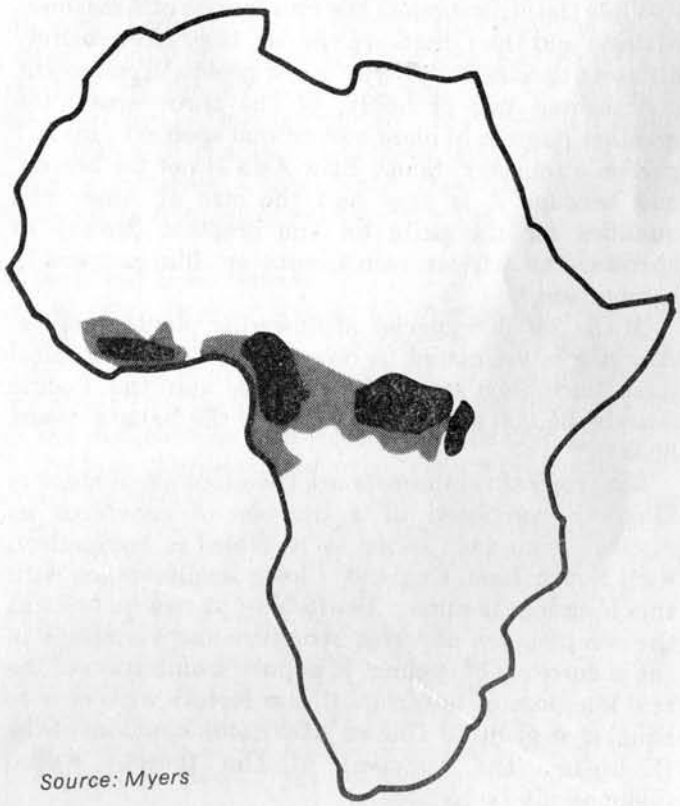
The nation of Malaysia has 7900 species of flowering plants while Britain has only 1422. The proportion of woody species is also high in tropical rain forests — between 30 and 35 per cent compared with 5 per cent for Western Europe. Brunei, the tiny state in north west Borneo has an area of only 5,000 square kilometres but a native tree flora numbering 2000 species. Britain, with a land area of 313,076 square kilometres has a meagre 35 native tree species.[89]

The great abundance of plants is linked with a diversity of distribution. Up to 200 different species of trees may be found in one hectare of rain forest in Malaya,[90] and one hectare may contain only *one* example of a particular species. Compare *that* with an English beech forest! Because the food of a certain forest animal is usually restricted to a few specific plants which will inevitably be scattered about the forest, the density of fauna is correspondingly low and is exacerbated by the fact that only a proportion of the individual plants of a certain species will be fruiting at any time.

While the tropical rain forests have been referred to thus far as if they were a uniform blanket of evergreen vegetation covering permanently humid areas of the tropics, nothing could be further from the truth. According to a classification by T.C.Whitmore there

Fig. 15: **AMAZON REFUGES**

Fig. 16: **AFRICAN REFUGES**



*Source: Myers*

Table 6. **THE MAIN FOREST FORMATIONS OF THE TROPICAL FAR EAST (Table 10.1 from Whitmore 1975).**

| CLIMATE | SOIL WATER | LOCALITIES | SOILS | ELEVATION | | FOREST FORMATION | |
|---|---|---|---|---|---|---|---|
| everwet | dry land | inland | zonal soils | lowlands to 1200 m | | 1 tropical lowland evergreen rain forest | 12b tropical rain forests |
| | | | | mountains | (750)1200-1500 m<br>(600)1500-3000<br>(3350) m | 2 tropical lower montane rain forest<br>3 tropical upper montane rain forest | |
| | | | | | 3000 (3350)m<br>to tree line | 4 tropical subalpine forest | |
| | | | podzolised sands | mostly lowlands | | 5 heath forest | |
| | | | limestone | mostly lowlands | | 6 forest over limestone | |
| | | | ultrabasic rocks | mostly lowlands | | 7 forest over ultrabasic rocks | |
| | | coastal | | | | 8 beach vegetation | |
| | water table high (at least period-ically) | salt water | | | | 9 mangrove forest | |
| | | brackish water | | | | 10 brackish water forest | |
| | | fresh water | oligotrophic peats | | | 11 peat swamp forest | |
| | | | eutrophic (muck and mineral) soils | almost permanently wet | | 12 a fresh water swamp forest | |
| | | | | periodically wet | | 12 b seasonal swamp forest | |
| seasonally dry | moderate annual shortage | | | | | 13 tropical semi-evergreen rain forest | |
| | marked annual shortage | | | | | 14 tropical moist deciduous forest<br>15 other formations of increasingly dry seasonal climates | monsoon forests |

are no fewer than 14 different types of rain forest, blending together in any area to form a rich mosaic. Even inside one of these types there may be differences in species composition between different parts of a region.[9] (Table 6).

While the structures of the rain forests of Amazonia, Malesia and the Congo are similar, they have entirely different species and there are few genera in common.[9]

Amazonia has probably, of the three areas, the greatest number of plant and animal species — up to 1 million altogether. South East Asia is not far behind, and because it is only half the size of Amazonia, qualifies for the prize for the greatest density of species. The African rain forests are like paupers in comparison.[9]

Of the 240,000 species of flowering plants, tropical America is estimated to have about 90,000, tropical Asia (including tropical Australia and the Pacific islands) 35,000 and Africa south of the Sahara desert 30,000.[14]

The tropical rain forests are therefore like a magical kingdom composed of a number of provinces as distinct from each other as is Wales in comparison with South East England. Closer acquaintance with this kingdom is almost bewitching as one marvels at the complexities of forest structure and variations in the occurrence of species. If popular admiration of the real kingdom of the tropical rain forests were ever to equal that given to Tolkien's fictitious kingdom of the 'Hobbits', the survival of the forests would undoubtedly be secured.

# It's Someone Else's Home too

Between 2 and 4 million species of plants and animals have their homes in the tropical rain forests. We have a duty to respect the right of fellow creatures to live in the environment which is suitable for *them* and to maintain the diverse vegetation upon which they feed.[89]

During our time on Earth we have changed the landscape considerably and it is possible that we have actually promoted greater genetic divergence by creating more varied habitats than had existed previously. But now, says Duncan Poore: "The changes are so rapid and unpredictable, and often so comprehensive, that many species cannot adapt and the loss may be greater than the gain."[90]

The tropical rain forests contain a large number of threatened species: 276 mammals, 345 birds, 136 amphibians and reptiles, 99 freshwater fishes, and 20,000 plants. At this moment we may be losing one species every day and this could rise to one species per minute if present trends continue.[9]

When a shipbuilding yard closes, throwing thousands of workers into unemployment, there is bound to be plenty of protest. But when tropical rain forests are removed and birds and insects lose their habitat, there are no dole queues for them. Extinction

is not a fairy story with a happy ending: it is forever.

Merely driving a new road through a forest in order to log it gives access to encroaching cultivators and poachers who will hunt the wildlife. In Central Sumatra only 300 Sumatra Tigers remain and they are being hunted to extinction.[91]

The gradual removal of their forest habitat severely affects animals who cannot live outside it. Wells estimates that of the 460 species of birds known to breed in Peninsular Malaysia, about 60 per cent are incapable of surviving outside the forest.[92]

Every animal has its own little niche in the forest. Purely by removing individual trees of part of the canopy, the habitat of certain species may be restricted although the forest as a whole still appears relatively healthy. When the African makore tree is felled for its timber, its fruits are no longer available as a food source for elephants. The bark of *Entandophragma utile* is also a favourite food of theirs but it happens to be valued for its timber by man.[93]

The absence of just a few plants which form part of an animal's complex calendar of food sources may result in its going hungry for critical portions of the year. The durian tree, notorious for producing fruits with an incredibly pungent smell, is pollinated by 3 species of bats, which visit the flowers between 8 in the evening and 1 in the morning. Since the durian only has two flowering seasons every year, each lasting 2 to 3 weeks, the bats have to feed on the nectar of other plants which flower at different times of the year. Among these are two valued timber trees, *Artocarpus spp.* and *Duabanga grandiflora.* But if these trees are extracted from the forest and are no longer able to feed the bats, who will pollinate the durian and its relatives?[89]

The flora and fauna in the forest are linked together so tightly it's almost as if they have a common destiny. Degradation of the forest means outright loss of habitat, but even species depletion can still have a considerable effect on the fauna whose vulnerability is exacerbated by the low density of individual species. There are 21 species of primates in the Borneo rain forest and one study[91] found only 1.4 primates per hectare of untouched forest. When logging or shifting cultivation intrude, animals get forced into smaller enclaves in which they will have to start competing with one another more vigorously for food.

Plants are often dependent upon just one or two insects for pollination. Despite the large number of species, insects live at a low density. Should just one species be made extinct, not only its associated plants will be affected but also other animals which depend upon that plant will be affected.

Animals living in a tropical rain forest where nothing changes from one millenium to the next don't have to bother about reproducing so avidly as animals in a more hostile environment, and annual birth rates may be only between 10 and 20 per cent of existing populations.[94] Such figures when combined with low population densities and the restricted ecological niches associated with each species mean that once it becomes threatened the path to extinction may be terribly quick. To conserve adequate habitat, as Whitmore urges, is not only a moral priority, but plain common sense.[9]

**Food Sources Threatened**

The world's plants are now under severe threat and the result of their loss would not just be to make the countryside less pretty.[95] Of the 250,000 flowering plant species catalogued so far — perhaps half the final total — 3000 have been used as food sources but only 150 of these have been cultivated as distinct from being collected from the wild. About twenty crops dominate the daily meals of people all over the world, and they come from the tropics, domesticated from wild plants just as we have domesticated wild animals like cows and sheep.[96]

More than one third of the world's cropland is accounted for by crops like wheat and barley which originated in the dry tropics of South West Asia (Middle East), as did lentils, peas, carrots, figs, dates, grapes, and pistachios.

Crops coming from the humid tropics should more than equal South West Asia's share of world cropland: tapioca, groundnut, cocoa, pineapple, brazil nut, cashew nut, passion fruit, and rubber from Brazil; sweer potato and papaya from Peru (with potato and tomato from the higher Andes); maize and guava from Central America; millet, kola nut, oil palm and sesame from West Africa; and bamboo, ginger, rice, yam, and cardamon from South West Asia.[97]

Thousands and thousands of harvests have enabled us to select the best varieties of crop so that every year we can rely upon a good yield — if weather is in our favour. Recently the plant breeder has accelerated the process of selection traditionally performed by the farmer, blending together favoured genes by complex crossing experiments to produce varieties with even higher yields.

With more and more people using a smaller number of high performance varieties, the previous wide spread of cultivars, often differing from one region of a country to the next, is diminishing. As varieties become highly specialised so they become more susceptible to changes in climate, and to attack by insects or disease. Consequently they may need to be replaced as frequently as every two years.[98]

**Protect our Gene Banks**

The plant breeder has at his disposal a 'bank' of genes which he can mix together to produce a crop with the desired characteristics. The gene bank includes all the many cultivars already selected, as well as the innumerable wild relatives to the crop.

The task of breeding is normally quite protracted. In order to produce a new high protein variety of sorghum, more than 9000 separate varieties of cultivars had to be investigated before two obscure strains were found being cultivated by peasants in Ethiopia, both of which had high protein contents.[99]

But if the diversity of cultivars is reduced then that job becomes even more difficult. The Green Revolution was launched with the high yielding super IR-8 rice. When this became susceptible to disease a new one had to be bred — IR-20. This too was hit by disease and

insects, and so IR-26 was born. Unfortunately it couldn't stand up to the high winds prevalent in the Philippines — centre of the Green Revolution. So the plant breeders looked for a more sturdy strain, but when they found it in Taiwan it had almost been totally replaced by the original IR-8.[34]

That was too close for comfort! We can no longer rely upon cultivars as a gene bank. Except for the odd crop like maize which does not exist in the wild any more, we shall have to turn increasingly to wild varieties for the ingredients of the plant breeder's cauldron.

After mounting attacks by greenfly on British potatoes the Ministry of Agriculture sent a team out to Bolivia and came back with a wild potato which had hairs on its leaves. This was crossed with the Pentland Crown variety and produced in 1979 as its progeny a potato just like we are used to but with hairs to trap the greenfly *before* they start eating away at the foliage. But what would have happened to Britain's staple vegetable if that wild potato plant had not been there?

We depend upon tropical food plants in a number of ways. Some which are grown in this country have their gene banks of wild relatives still in the tropics. Others, like cassava are not grown in this country but provide the staple food for large numbers of people actually in the tropics, or are grown in the tropics and shipped to us, as in the case of cocoa. The tropical rain forests are the world's richest gene banks, and as they start to disappear, so do our options. It is just like walking out on a plank and starting to cut away at the wood behind with a saw. A country like the U.S.A. in which indigenous crops account for only 0.1 per cent of the area under cultivation is extremely vulnerable in this respect. Genetic engineering isn't much good if gene banks are being eroded.[97]

**Cash Crops**

Man has snatched just a few of those thousands of plants out of the forest and cultivated them for sustenance and employment, as well as to create wealth. Major cash crops have been dispersed perhaps over to the other side of the world far away from their wild starting points.

Cocoa was first brought to Ghana from South America in 1879 and in 1977 Ghana's 249,000 tons of exports represented just over 25 per cent of world trade and brought in 670 million dollars, with most of the production taking place on small peasant farms. Nigeria, Ivory Coast and Brazil are also prominent producers.

Brazil was also the home of the rubber tree *Hevea brasiliensis,* but seeds were taken by Henry Wickham to Kew Gardens in 1876 and sent from there to Ceylon where the first rubber plantation in the Far East was established.

Today South East Asia has over 90 per cent of the world trade in natural rubber of 2.5 billion dollars a year. Exports from Peninsular Malaysia are valued at 1.3 billion dollars (1977) with Indonesia's share standing at over half a billion dollars.

In return, Brazil obtained coffee bushes from Africa. Of a world market in coffee worth nearly 12.5 billion dollars in 1977, 2.3 billion dollars of coffee came from Brazil and 1.5 billion dollars from its neighbour Colombia.

There are an estimated 2000 species of palms growing in the rain forests out of a world total of 2700[100] . South East Asia dominates the market in the palm oil which as raw material for soaps, detergents etc. is very important in international trade. Peninsular Malaysia's exports are valued at 619 million dollars and Indonesia's at over 185 million dollars. The growing of coconut palms is evenly spread throughout the humid tropics, with world trade in coconut products worth over 1 billion dollars in 1977.

**Cash Crops Vulnerable**

The relatively small number of cash crops introduced by colonists have remained a major source of income for many developing countries, yet they too are threatened. As monocultures they are vulnerable to diseases, e.g. cocoa has been hit hard by swollen shoot disease.[101] About half a billion dollars every year is spent on keeping ahead of diseases and pests threatening groundnuts, and such a sum is not unusual.[40] Gene banks are important for them too.

Large scale conversion of tropical forests to cash crop plantations has caused widespread soil erosion and environmental deterioration as in the case of coffee in Brazil, yet with good management it has been shown in the case of tea that such damage is not inevitable.

Very often the balance between the introduction of cash crops and retention of natural tropical rain forest falls in favour of the former, e.g. cocoa plantations are steadily eating into the northern border of the West African rain forest. The danger is that not only will this erode the gene bank of other essential crops, but so affect the environment that the very survival of cash crops in that area is open to question.

Coffee was grown throughout Parana state on the east coast of Brazil. Suddenly frosts became frequent, ruining the crops and driving the plantations to Minas Gerais, a state which had (Fig. 17) never experienced forests before. In 1979 frosts struck at the coffee plantations in Minas Gerais with a loss of 6 million out of the expected national harvest of 26 million bags .[102] Brazil's 1978 coffee exports were worth 2 billion dollars. Is the spread of frost *just* caused by local deforestation or is reduction of the Amazon rain forest a contributing factor?

Something similar is happening in South East Asia. In recent years oil palm plantations have been hit by severe droughts. With up to 6 months of low moisture levels in the subsoil, there are fewer flowers and lower production of fruits. Malaysia alone has lost about 200,000 tons in one year.[103]

**Forest Medicines — a Cure for Cancer?**

Each plant in the rain forest has its 'chemical fingerprints', a unique blend of quite complex chemical constituents whose test tube preparation often has chemists scratching their heads. The balance of properties of the constituents often gives rise to

pronounced effects should they enter the bodies of animals or human beings, and the great variety of plants is used by Amazon Indians just as we would pick a record from a shelf and play it to put us in a certain mood.

Learning from the Indians has, as we have seen with the work of Dr Gorinsky above, great potential for improving our *materia medica*. It has been estimated that about 47 per cent of all new prescriptions written in the United States each year contain a drug of natural origin as the sole active ingredient or as one of two or more main ingredients, with a large proportion of these having a botanical origin.[104]

The first thing many people consume in a morning is an alkaloid, whether it is caffeine in a cup of tea or coffee, or nicotine in a cigarette. The large group of similar chemical compounds known as alkaloids is very important in that it is called upon to produce many of the drugs in daily use in the modern world.

Alkaloids are found in up to twenty per cent of flowering plants but only two per cent of plants have so far been screened for their alkaloid content.[14] The first modern tranquilizer, reserpine, was extracted from Indian snakeroot, *Rauwolfia serpentina* which has been used as a folk medicine for more than 3000 years, first appearing in Hindu medical texts in 1000 B.C. It was highly valued as a treatment for snake bites and poisoning, insanity, fever, and digstive problems.

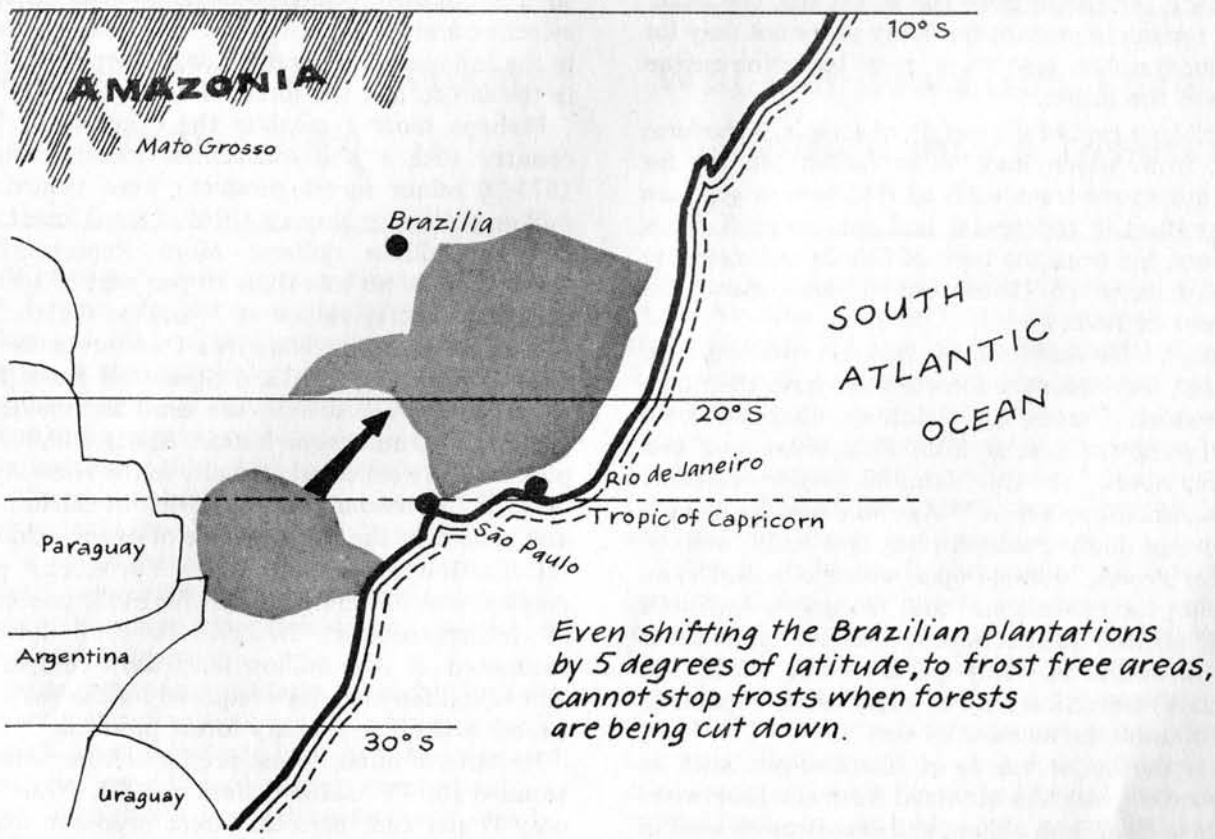
The U.S. National Cancer Institute takes botanical medicines very seriously. Already two alkaloids, vincristine and vinblastine, have now given patients an 80 per cent chance of remission in cases of Hodgkin's Disease, 99 per cent for acute lymphocrytic leukaemia and between 50 and 80 per cent for other forms of cancer.

The alkaloids are just two out of 75 contained in *Vincas rosea*, or Rosy Periwinkle, a woody tropical shrub which grows up to two feet in height. It is distributed throughout the tropics in countries such as Jamaica, Philippines, Madagascar etc, where there are traditional uses as folk medicine, and belongs to the same family of plants as Rauwolfia mentioned above. With this success tucked under its belt the National Cancer Institute (NCI) spends one and a half million dollars a year on collecting and screening plants for alkaloids with potential for treating cancer. So far 29,000 species of plants have been screened.

Another group of chemical compounds which is part of our everyday lives are the steroids. In 1943 an American, Dr Russell Marker, succeeded in preparing the human sex hormone progesterone from steroids found in the Mexican Wild Yam Dioscorea. While this substance enabled women in some cases to overcome sterility, other hormones prepared from Yams have been the basis of the contraceptive pill.

With the value of medicines originating in wild plants such as yams from the Mexican jungle put at over 3 billion dollars a year in the United States alone, and the frantic search by drug companies and cancer researchers for new remedies by screening thousands of wild plants every year, the destruction of plant habitats such as the tropical rain forests of the world would not only be a material loss in terms of plants

Fig. 17: **SHIFTING THE COFFEE PLANTATIONS**



unexploited, it could also mean the difference between success and failure in the fight against cancer.

**Minor Forest Products**

Drug researchers are not unlike the 200 million people living in or on the edge of forests who depend upon what they can collect inside for sustenance and even their livelihoods. In many cases what they gather never reaches the market, e.g. fuelwood, and so a mere commercial evaluation is a great underestimate.

Despite this limitation the 'minor' forest products which do reach the market add up to form a large chunk of total forest income. Brazil nuts can only be gathered in the forest, while at least 90 per cent of rattans in Indonesia are collected from the natural forest.

Indonesia has a 90 per cent share in the world rattan market, utilising 50 species from about 300 rattan yielding palms and exporting in 1974 53,500 tons valued at 3.5 million dollars. Attempts are being made to cultivate rattans outside the forest but the latter will still remain important for many years not only for its production but also as a gene bank for rattan breeders of the future.[105]

About 20 per cent of the weight of a log is in the form of bark, from which may be extracted tannins for dyeing (mangrove trees such as *Rhizophora spp.* are very important in Indonesia), and anti-malarial drugs such as quinine from the bark of *Cinchona ledgeriana* which originated in Brazil but is now grown on plantations in Java.

Although *Hevea brasiliensis* is widespread throughout Indonesia the forests there have their own latex producing trees e.g. jelutong obtained from *Dyera spp.*, gutta percha from *Palaquium spp.* and other members of the families *Apocynacaeae, Moraceae,* and *Sapotaceae.*[106] *Agathis,* besides being a fast growing high grade timber tree may well be tapped for a resin, Manila Copal, which is valued as an ingredient for varnishes and lacquers, without affecting timber production. Pines are significant sources of resins in many parts of the world and Indonesia's production may be expected to expand as its pine plantations increase in size.

India is the major source of essential oils such as sandalwood oil which is obtained from the heartwood and roots of Santalum album; and sassafras oil used in cosmetics, disinfectants, and insecticides comes from Brazil's *Octotea pretiosa.* Indonesia intends to expand its oil extraction industry, with *Cinnamomum porrectum* having potential as a source.

Beside firewood, many trees and plants contribute to the subsistence of forest dwellers or forest neighbours, e.g. the sago palm, durian and mango trees, and trees producing nuts like betel and illipe, not to mention the value of forest wildlife as part of the regular diet of local people.

Between 1971 and 1975 exports of minor forest products from Indonesia increased by 38 per cent to 128,737 tonnes and their value doubled to 21 million dollars. While timber exports increased by only 29 per cent, their value almost tripled to 490 million dollars so that minor forest products in dollar value went down from 7 per cent of timber exports in 1971 to 4 per cent in 1975.[107]

**"If deforestation continues at the present rate, the Brazilians could very well end up creating another Sahara". Dr. Harry Knowles.**

The Indonesian forestry situation is abnormal at the moment as large numbers of logs are being sold off. There is a great danger that what is a *continuing* source of forest income may be prejudiced by forest destruction. In 1973 exports of illipe nuts (processed to give a fat used in the chocolate industry) were worth 3.17 million dollars which while only 0.5 per cent of log exports in that year was by no means insignificant. Illipe trees can be grown in a variety of environments and have the advantage of fruiting regularly.[108]

At the moment nuts are gathered from wild trees such as *Shorea stenoptera Burck,* and with proper selection and cultivation illipe could play a greater role in the Indonesian economy, but the gene bank is found in the forest, and the forest is disappearing![49]

Perhaps more typical is the example of India, a country with a well established forest industry. In 1975-76 minor forest products were valued at 125 million dollars or about a third of total forest revenue of 348 million dollars. More importantly they accounted for no less than 70 per cent of total forest products exports valued at 71 million dollars.[109]

Balu leaves from *Diospyros* trees are collected and used as wrappings for local cigarettes. Seeds from the sal tree, *Shorea robusta* are used for making soap, vegetable oil and cocoa butter. About 600,000 tons of pine resin are collected annually in the Himalayas. The bark of *Terminalia ardjuna* is rich in calcium oxalate and is used in the manufacture of oxalic acid.[110]

Collection of minor forest products provides employment for millions of people in the poorer sectors of Indian society. In 1973-74 total labour was estimated at 346 million man days compared with 135.42 million man days required for the harvesting of timber and other primary forest products.

Exports of minor forest products from South Korea totalled 100.77 million dollars in 1977. While this was only 17 per cent of total forest products exports, it must be remembered that the country imports a lot of timber from outside the country for processing and re-export.

On a national basis, the production of minor forest products in South Korea in 1976 was valued at over 221 million dollars, compared with over 108 million dollars for the primary forest products (including fuelwood).[107]

"Minor" forest products are no longer the small guys in the forestry world. They are an integral part of the forest economy and the forest industry and will remain so when timber from primary forests has been logged out. Their contribution is threatened by deforestation and a number of countries are seeking to establish their cultivation in the form of plantations outside the forest.

Jutta Hosel-Habitat

## Will Biological Maintenance Break Down?

We have been made aware in recent years of the way in which forests are intimately connected with the maintenance of life on this planet as far as their participation in the essential cycles of water, oxygen, carbon and nitrogen are concerned. It has even been argued that this protective sustaining function may be even more important than the production of wood.[111]

If the forests should disappear how will this biological maintenance be affected? Despite the fact that this is by no means an unimportant topic, very little scientific attention has been devoted to it and so consequently there is a lack of reliable data upon which to base a sound judgement.

The consequences of deforestation already discussed are sufficiently alarming as to demand attention at the highest level. The loss of our biological heritage and threats to the world food supply can stand by themselves. The ability to produce food will also be affected should deforestation cause climatic change or soil erosion.

The available evidence *suggests* that the possibility of breakdown at both regional and global levels is sufficiently real for us to take the matter seriously. It may take 20 years before we are sure about the reality of global warming due to deforestation. By that time, says Dr Mustafa Tolba UNEP Executive Director: "it could be too late to do anything about it, and climatic changes could have already occurred with significant environmental impacts, such as alteration of precipitation and evaporation regimes or melting of Arctic Ice."[112]

## Will Deforestation Turn the Amazon into a Desert?

We normally associate deserts with dry areas, yet Harry Knowles, a former FAO ecologist who has spent 22 years in the Amazon region has predicted that: "If deforestation continues at the present rate, the Brazilians could very well end up creating another Sahara."[113] But how could one of the wettest parts of the world become one of the driest? Surely the rich covering of vegetation must mean that the Amazon soils are very fertile and long lasting?

Nothing could be further from the truth. Soils beneath tropical rain forests are generally very poor, and heavy rainfall of up to 4000 mm (157 inches) has long ago washed most of the plant nutrients from the topsoil. Contrary to what is found in temperate areas, the fertility of an area of tropical rain forest is stored in the vegetation and not in the soil.[5] Nutrients from dead organic matter are returned back to the vegetation as quickly as possible via the intermediaries of ants, termites and fungi, and if such a closed and rapid nutrient cycle was not in operation the nutrients would be leached down to the subsoil and as they would be lost to the surface plants so the overall fertility of the land would decrease.

The region of Bragantina around the eastern Amazon city of Bragantina was settled just before the end of the nineteenth century by European and Brazilian farmers. Year after year the fertility dropped until by the 1940s only coarse grass would grow there. Now all that is left is a ghost landscape with large areas of bare soil and rock. Crops gave high yields intitially but as more and more of the finite fertility of the land was taken away to feed people, the soil became exhausted and a desert was formed.[113] Settlers along the new Amazon Highway BR 174 must

have been very surprised when crops failed after a few years. Now the fields are abandoned, the soil is eroded, and desert is spreading like a plague in all directions.[114]

**Poor Soils**

Fertile soils only cover about 4 per cent of the Amazon Basin area and these are restricted to the *varzea* land which is seasonally flooded by the river and has its fertility enriched with a fresh supply of silt just as in the case of Egypt's fertile Nile Valley.[115] In South East Asia, Java's soils are fertile because they are topped up every so often when one of the island's 112 volcanoes erupts.

But these are exceptions, for the most part the old base rich rocks of humid areas in South America and Africa have weathered to a mixture of kaolinite clay and iron and aluminium oxides. Because of the basic conditions the acidic silica has been leached out of the clay leaving behind the iron and aluminium oxides to give a red or yellow colour to the upper soil layer and form *latosols*.[116]

South East Asian rocks are younger and less basic, and although they may be red or yellow in colour, still have a substantial layer of clay in the subsoil and are known as red-yellow podzolic soils. These can eventually turn into latosols. Both were previously known as lateritic soils.

The Amazon Basin is a rolling plain, rising and falling for up to 5 metres about mean river level. Latosols on the tops of hillocks have been found to alternate with podzol soils in the valleys. The podzols originated after iron oxides had been leached out of the sandy soils owing to the acidic conditions.[117] This is the exact opposite of the process by which latosols are formed, and the heath like vegetation in the valleys is not as rich as the forests on the latosol hilltops. The sandy soils are much more susceptible to erosion.

**Laterization**

Latosols and red-yellow podzolic soils used to be known as lateritic soils but their names were changed because they were confused with the substance known as laterite which is found as a hard red crust on exposed soil surfaces. as individual nodules, or as a continuous layer of subsoil blocks in areas with a monsoon climate where there is up to three months of seasonal drought.

The process by which laterite is formed is known as laterization, and this cannot happen if the soil remains moist. During a drought period, a soil without vegetative covering will be exposed to the heat of the sun which will cause soil moisture to evaporate from the surface and as it does so it will pull up more water from beneath the surface by capillary action. This will bring with it oxides of iron and aluminium which will be left behind on the surface when the water evaporates. It is then baked hard into a concrete like covering called laterite.

Theoretically, in permanently humid areas like the Amazon Basin the red laterite pavements found frequently in Africa and South East Asia should not occur. Yet Mary McNeil, in an article in *Scientific American* has described how: "At Iata . . . in the heart of the Amazon Basin, the Brazilian Government set up an agricultural colony. Earthmoving machinery wrenched a clearing from the forest and crops were planted. From the beginning there were ominous signs of the presence of laterite. Blocks of ironstone stood out on the surface in some places, in others nodules of the laterite lay just below a thin layer of soil. What had appeared to be a rich layer of soil with a promising cover of humus disintegrated under the first or second planting. Under the equatorial sun the iron rich soil began to bake into brick. In less than 5 years the clear fields became virtually pavements of rock.."[118]

Eye witness reports such as this, and documentary evidence of the formation of desert like areas in other places[119]suggests that deforestation has been accompanied by a change in the climate. How could this happen?

**Climatic Chance**

There are two authoritative and documented reports of climatic change after the removal of tropical rain forest and subsequent cultivation. The first, by Dr Harold Sioli who is Director of the Max Planck Institute of Limnology in West Germany, has described how slash and burn cultivation in the Amazon has transformed luxuriant high forest into extensive stretches of stunted scrub. "The nutrient storage of the former forest community, as well as the water holding capacity of the soil must have been upset and local changes in climate in the form of longer droughts have been produced as a result of large bare areas."[120]

More evidence appears in the UNESCO report and involves a study of the long term changes in rainfall when tropical rain forest in Malaysia was transformed into rubber plantations. "While the total annual rainfall appeared to remain unaffected, the number of rainfall incidents decreased and the intensity per rainfall increased."

The UNESCO Report itself states that: "There are good and fact supported reasons to believe that generally forest destruction will increase aridity and put the natural ecosystem out of balance with a corresponding loss of dynamic equilibrium and reduction of power of recovery by intrinsic control mechanisms. Eventually effects will spread to regional and larger scales."[5]

The amount of rain falling upon an area is influenced by the nature of currents of hot air rising *from* the land and also by the way in which winds move *over* the land. Tropical rain forests have undulating canopies with a large proportion of emergent trees and so are aerodynamically very rough. Replacing them by rubber plantations with a much smoother surface can therefore also change the character of the rainfall. As trees are more and more removed from the land so the probability of long dry periods becomes greater, both because of aerodynamic changes and also because the surface reflectivity or albedo is increased. This will be discussed in detail below, but enough evidence does exist therefore to conclude that an aseasonal humid climate *can* become seasonal, and should this happen

then so do the soils become prone to laterization.

**A Vicious Spiral**

Large areas of the Amazon rain forest have been converted into pastureland. Will this by itself change the climate, and if in the future we see the error of our ways shall we be able to restore the forest or allow the forest to regenerate?

This is an extremely important question since large areas of savanna grassland in Africa and America are located in regions which should by virtue of their climate be covered with forests. It is believed that early man burned down the forests not only as a hunting aid to scare his prey out into the open or into a trap, but also in general to remove from them a very convenient hiding place.

Regular burnings have prevented regeneration and modified the climate to secure the domination of the grasses which took over from the trees. As far as shifting cultivation in tropical rain forests is concerned it has been suggested that the growth of weeds such as alang alang grass may be just as important in determining the period of cultivation in one place as is the reduction of yields. Of the 21.14 million hectares of forest in East Kalimantan about 2.4 million hectares is covered by secondary forest and 372,000 hectares by alang alang.[121]

The regrowth of secondary vegetation in clearings is one of the great unexplored areas in tropical rain forest ecology but there are three possible ways in which the forest could return. Dormant seeds of trees could remain behind after clearance and cultivation and then sprout up: while this could happen in the forests of temperate Europe, the dormancy of seeds of many species in the tropical rain forest is measured in weeks, and some seeds germinate at once. Pioneer species like Macaranga may be expected to colonise the area since they are able to grow in full sunlight. Only when pioneers have established a shading canopy could the Dipterocarps start to grow.[9]

The rate of recovery of the forest will probably be related to the size of the clearing and the nearness of seed producing trees. Dipterocarps bear fruit irregularly and the efficiency of dispersal is very poor. To restore the mature forest seeds from about 100 different species will have to find their way into a one hectare clearing. Since 60 per cent of birds inhabiting a tropical rain forest are incapable of living outside it, any assistance from them in seed dispersal could not be relied upon.[122]

The third possibility would be for isolated trees persisting in the cleared area to flower, fruit and distribute seed. Should a few trees remain, whether or not they would attract pollinating animals from nearby forest is debatable.

Given time, it is possible that a logged or cleared forest could revert to its climax vegetation. With increased activity of encroaching cultivators there is a high probability that further clearance would take place before this time. The picture then is one of increasing conversion — at best — to secondary forest or grassland in a certain area. The modified climate could then exert a positive feedback effect restricting the type of vegetation which could grow in that area. The result — a vicious spiral which in the case of more extreme clearance operations in the Amazon may lead to irreversible changes in local climate and vegetation.

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**Our lack of knowledge of the world's forest resources is abysmal . . .**

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# Replacing the Water Economy

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In tropical rain forest areas the vegetation is a key intermediary between the soil and the large volume of water regularly cycling through or being stored in the ecosystem. The removal of that vegetation could cause a localised decrease in precipitation and drying out of the soil with a consequent increase in vulnerability.

On the larger scale water vapour passes through the four key stages of watershed catchment, river drainage, wetland storage and ocean sink before returning to the atmosphere. The loss of forests would affect each one of those stages.

**Vanishing Watershed Forests**

The layers of vegetation covering a hillside serve to deccelerate the drops of rain whose impact would otherwise have a very destructive effect on the soil particles, which added to the disintegration of soil crumb structure and mineralisation of humus which binds it together, would make soil erosion very likely.

One study has shown that while a watershed covered with natural rain forest loses 1 ton of soil per hectare per annum owing to soil erosion, between 20 and 30 tons may be lost should the forest be removed and the land cultivated. Another study in the Ivory Coast found negligible erosion (0.03 tons/ha/yr) on land with a 7 per cent slope covered with secondary forest in the Ivory Coast, with 90 tons/ha/yr lost when annual crops were cultivated and 138 tons/ha/yr when the ground was left bare.[6] (Table 7).

Besides an increased silt load in the river, the volume of water in the drainage system at any time will vary between extreme values if the watershed forest is removed. A well forested watershed will only release between 1 and 3 per cent of total rainfall by surface run off, with the majority of drainage water travelling underground and being released slowly, rather than in a massive flood as on a bare hillside. Increased surface run off will exacerbate soil erosion.[5]

The world's major watersheds such as the Andes draining into the Amazon Basin, and the Himalayas draining onto the Indian sub-continent, are threatened

Table 7: **EFFECTS OF WATERSHED LOSS**

| | Erosion tons/ha/yr | Surface Run-Off % of Rainfall |
|---|---|---|
| Watershed covered by Rain Forest | 1 | 1-3 |
| Watershed cultivated | 20-30 | Massive floods |

**HEAVY EROSION:**

Carries away fertility
↓
Silts up Rivers
↓
Raises Rivers Beds . . Causing . . Makes reservoirs useless

**HIGH SURFACE RUN-OFF**

Water delivered in large amounts infrequently
↓
Flooding of Banks
↓
Burst dams
↓
Destroys Irrigation Systems

by deforestation whether it be for collection of firewood or shifting cultivation. It has been estimated that 40 per cent of the human population lives in river valleys adjacent to these upland catchment areas[123] and here also are located considerable areas of highly intensive irrigated agriculture. Both lives and crops are placed at risk when the trees are stripped from the mountainsides.

**South East Asia**

To feed its massive population of over 76 million, Java has constructed an incredibly intensive system of farming based on rice paddies or sawah and dependent upon very intricate irrigation systems, Owing to the activities of shifting cultivators and firewood gatherers in the upper basin of the Solo River up to 4 centimetres of subsoil are lost every year with large areas already eroded to bare rock.[123]

The silting of irrigation channels downstream has already got completely out of hand and farming has been extended to even the steepest of slopes. In the early nineteenth century the watershed was covered with large areas of teak forests and since 1973 international agencies like FAO, UNDP, and latterly the World Bank have been helping Indonesia to restore the forest cover.

The situation on the watershed of the Citarum River is similar, with a sevenfold increase in the silt load over just three years owing to accelerated soil erosion. Mountain peaks covered with dense jungle as recently as 1950 are now fully planted with cassava and other root crops.[123]

Most of the rich lowland forests of Peninsular Malaysia and Sarawak have already been logged and so the loggers are now busy in the hill forests. The same is happening in the Philippines, but because of heavy logging in the watershed of the upper Agno River, the life expectancy of the Ambuklao Dam — built to last sixty years — has been cut by half.[4] It seems utter folly to spend millions of dollars on prestige irrigation schemes linked to reservoirs producing hydroelectric power and yet fail to protect that investment by conserving the watershed vegetation, without which the dams will silt up and eventually become inoperable.[124]

**South America**

Unlike South East Asia, the mountains are the traditional homes of the people of South America and it is here that the great Aztec and Inca civilisations had their origins. But populations are growing rapidly. Between 1950 and 1975 Peru's numbers shot up from nine million to fifteen million, and those of Colombia more than doubled from eleven million to twenty five million.[123]

To find land for growing crops, the farmers are moving higher and higher up the slopes of the Andes, getting as much out of one plot of land as they can before moving on to another a few years later. When they go, the soil leaves too, washed down by the next shower of rain. Trees are ripped up by their roots to heat houses and cook food in these chilly highland areas.

Erosion, landslides and sedimentation from watersheds literally breaking apart are wreaking havoc in the towns and farming lands in the valleys of Peru, Bolivia, and Colombia. The mountain people are also moving down the slopes, removing the vegetation as they go and colonising the Amazon from the east as well as the west.

The Amazon city of Maraba is situated near the meeting point of the river Araguia and Tocantins and is the centre of a large deforested area. The rivers are full of silt and regularly flood Maraba every year.[113] Ten years ago the whole of Brazil was reported to be losing 500 million tons of fertile soil annually. While that may seem a lot it averages out at 16.6 tons per hectare of cultivated land which is modest compared with the figure of 90 tons measured in the Ivory Coast. It would be interesting to revise the estimate of national soil loss in the light of recent developments.

**India**

The situation in the Himalayas is similar to that of the Andes. Analysis of satellite pictures by Mr P.N.Gupta, the Conservator of Forests for the state of Uttar Pradesh, reveals that forest cover is as low as 15 per cent in one of eight districts comprising the hilly part of the state, compared with the figure of 60 per cent[125] prescribed by national forestry policy for that region.

India has 1.5 million square kilometres of catchment area in the Himalayas and yet soil conservation measures have been applied to only 11,000 square kilometres. Not more than 25 per cent of the whole watershed area is covered by forests and while it is right to concentrate on the high silt producing areas in the catchments initially, the work done covers no more than 10 per cent of this smaller area. "The afforestation programme," says *The Times of India*

"has been going at a snail's pace."[126]

In the late summer of 1978 disaster struck. The heavy monsoon rains flooded down the slopes, unrestrained by forest cover, so that by September 14th the Indian High Commissioner in London Mr N. G. Goray was saying: "We know now that the entire Gangetic plain stretching from Delhi to Midnapur has been turned into a vast watery grave. Parts of the City of Delhi, Agra, Allahabad, and Patna are in danger of being wiped out by the floods and the states of Uttar Pradesh, Bihar, and West Bengal lie writhing in agony. The entire economic fabric built by the people in the riparian region with so much patience and toil during the last many centuries has been uprooted and it is now lying covered under the thick and slimy layers of mud."[127]

After the second flood, the Irrigation Secretary in West Bengal stated that 1,291 people and 426,687 head of cattle had lost their lives; 1.5 million houses had been wrecked or damaged; 42.78 million people affected, and 49 million acres of land inundated of which 17.6 million acres were cropped areas. The total loss was estimated at £130 million.[128] Then in the last week in September the state was struck by its third flood in less than three months and figures released on October 8th gave 2 million people as being homeless and 600 lives lost.[129]

West Bengal is one of India's major industrial centres, with two of the country's five steel plants located there. They had to close, as did at least 46 out of the 136 coal mines in the state. Nearly all the jute fields and rice paddies were washed away. Warehouses in Calcutta and Haldia containing jute manufactures and half of the annual jute harvest were 10 feet under water. The Minister of Industry estimated the damage to be £1.2 billion.

The Government of India is putting its faith in building yet more dams and other costly engineering measures to stop the floods. If one dam silts up, then a new one is built downstream. On August 12, 1979, the floods came again, this time bursting a dam and unleashing a 15 foot high wave of water and mud on the industrial town of Morvi in Western Gujarat, killing up to 15,000 people. More than one Indian must have seen this tragic episode as having some divine comment to make on India's faith in dams.[130]

India's predicament is a good example of what lies in store for the people of South East Asia and South America. The country is not alone in the short sighted way in which it treats its forests. Mr Shankar Ranganathan has calculated that it would cost nearly 48 billion dollars to construct even earthwork reservoirs to store the same volume of water which the forests should soak up and release every year, and considering the loss of crop production and soil nutrients due to flooding and soil erosion attributable to deforestation, he puts the annual value of India's forested watersheds at 72 billion dollars.

Mr Ranganathan sympathises with the Forestry Department which has developed an inferiority complex owing to the fact that forestry only contributed 2 per cent of the GNP in 1973 compared with 40 per cent from agriculture, yet if he is right, the forests are indeed India's "billion dollars greenbacks" and the very foundation of its economy.[131]

**Wetlands Disappearing**

The drainage of wetlands such as swamps has been pursued with almost evangelical determination in the last century or so. Yet in doing so we may be losing a very productive resource that is the permanent home for many fish as well as a temporary home for migrating birds.

But their greatest importance, according to Kai Curry-Lindahl, "may be as a hydrogeographically stabilizing element within a drainage basin, watershed, or ecosystem. Wetlands function as sponges, accumulating excess water during floods, storing it for months, and distributing it during drier periods. They are important for the maintenance of the ground water table in vast subsoil areas. They are essential for the welfare and fertility of a country, preventing catastrophies resulting from the violent floods and from the drying out of land. The value of marshes and swamps as safety valves in the hydrographic system of a watershed area and drainage basin cannot be overestimated."[132]

It is with some concern that we see the disappearance of both the Amazon watersheds and the Amazon swamp lands in view of the fact that at any one time two thirds of the world's fresh water is located in the Amazon Basin. The Amazon discharges 18 per cent of the world's fresh water into the oceans, the Orinoco 2 per cent and the Congo only 3 per cent. Obviously a considerable amount of water is lost to the atmosphere by evapotranspiration before it can drain out to the sea. In a study of the Amazon Basin area with 3500 mm annual precipitation. evaporation was estimated at 1500 mm and run off at 2000 mm every year.[5]

First of all, consider the effect of increased water discharge from the catchment areas as their forest cover decreases. This is going to lead to a rise in the peak river level and an increase in the area of seasonally flooded land. The swamps near the river will be able to provide their traditional protective function if they are safeguarded. Otherwise larger areas of the Basin will be inundated, threatening not a few of the grandiose agricultural or mining development schemes now being implemented or planned. Already the river level at Manaus is rising substantially more during the floods than ever before. Brazil is investing 3 billion dollars on the Tucurui hydroelectric scheme with eight 360 MW turbo-generators due to come on stream by 1983 and a final output of 8000 MW. This will substantially increase Brazil's electrical generation capacity and help save on its heavy oil bills. More importantly, it will supply energy to new aluminium shelters being built about 50 kilometres south west of Belem using bauxite from Trombetas, and to industries processing iron ore from the vast reserves at Carajas to the south. Tucurui is situated on the lower Tocantins river whose heavy flooding and silt load could threaten the success of the Tucurui project, the lynchpin for the economic development of the whole northern region of Brazil.

**Back to the Water Cycle**

There is something slightly worrying in playing about with two thirds of the world's fresh water. According to the UNESCO Report tropical oceans are responsible for 49 per cent of all water evaporating into the atmosphere and tropical land surfaces just 9 per cent. The fact that all the tropical forests only evaporate 3 per cent of atmospheric water input could be reassuring.

However, while all the water will probably evaporate into the atmosphere in *some* way whether the Amazon rain forest is there or not, it is the way in which evaporation takes place which is important and deserves study.[5]

The Amazon Basin is like an inland sea not only in the massive volume of water which it contains, but also in the way that a large fraction of the water which is lost to the atmosphere by evaporation or transpiration returns to the Basin in the form of rain. Precipitation at the ocean surface is on average nearly 92 per cent of evaporation.[123] What will happen to the volume of water at present pushed by evapotranspiration into the atmosphere above the Amazon Basin? If it decreases, then so could the returning rainfall. The Amazon would become a much drier place.

**Changes in the Global Heat Balance**

If our planet is not to become overheated, then it must maintain a balance between all the energy coming in from the sun and that which is radiated out into space. Of the energy which reaches the earth's surface some is reflected and some absorbed. The reflectivity of a certain area (known by the term 'albedo') increases as the complexity of the vegetative cover decreases. Forests have a low albedo while deserts have a high value.

On the energy absorbed, a fraction is stored in the carbohydrates of the vegetation which we use as food and fuel sources, but 40 per cent of all the energy incident upon the forest is used to power evapotranspiration.[133] This process is very energy demanding because of the latent heat needed to turn water from liquid to vapour. Since this latent heat is released again when the water vapour condenses in the atmosphere, evapotranspiration can be seen as an important method for transferring heat from earth to atmosphere.

The Earth has been compared with a gigantic heat engine, and climatic effects such as winds, ocean currents, rain and snow precipitation are some of the methods of heat transfer by which this delicate engine is kept in balance. Climatologists consider the ratio between the amount of heat lost directly e.g. by reflection and indirectly by evapotranspiration so important as to merit a special name — the Bowen Ratio.

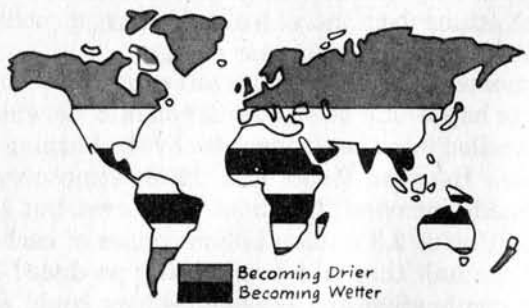
If the Amazon or other rain forests are removed the the albedo will increase, and this could itself decrease the rainfall received by an area by altering the convection currents of air rising from the ground.

Franzle, a German scientist, has calculated that deforestation of the Amazon Basin would so increase the amount of heat lost by reflection and decrease that lost by evapotranspiration that the Bowen Ratio would increase from 0.33 to 0.5[134] . The situation is further complicated by the likelihood of more dust being thrown up into the atmosphere as soil erosion and desertification become endemic, and this would reflect more solar energy back into space so reducing the proportion reaching the earth's surface.

The United Nations Environment Programme (UNEP) is concerned about the climatic effects of tropical deforestation. Dr R.J. Olembo, Deputy Director of UNEP's Environmental Management Division has predicted that the overall result could be a weakening of crucial aspects of global air circulation and cooling in the upper atmosphere which would lead to: "increased precipitation in the latitude bands 5° to 25° north and south of the equator, and increased meridional transport of heat and moisture out of the equatorial regions and ultimately to global cooling and decreased precipitation between 45° and 85° north and 40° and 60° south of the Equator, (Fig.18).[135]

Rainfall near the Equator would therefore decrease, but increase nearer to the Tropics. Britain and the northern U.S.A. and Canada would become drier places and the whole earth would become cooler. "Such a scenario", says Olembo, "if it were confidentially predicted, should give us sleepless nights, for without doubt, the consequences on this earth would be catastrophic."

Fig. 18: CLIMATIC EFFECTS OF DEFORESTATION OWING TO CHANGES IN THE BOWEN RATIO (After Olembo)




# Will we run out of Oxygen

**The Role of Tropical Rain Forests**

There are two ways in which the loss of tropical rain forests *could* affect the level of oxygen in the atmosphere: reduction in the cycling of oxygen by photosynthesis and consumption of oxygen when the wood from felled forests is burnt. This section will assess the significance of these two possibilities.

It has been estimated that about 32 per cent of all oxygen produced by land vegetation comes from the tropical rain forests, and recent research has overturned the long held assumption that the majority of the earth's oxygen is produced by plankton in the oceans. Land vegetation is now believed to account for two thirds of all oxygen produced on the earth.

The tropical rain forests produce a lot of oxygen firstly because their biomass per square kilometre is very large and secondly because they are able to operate all the year round without being interrupted by seasons. More vegetation is packed into a square kilometre of tropical rain forest than anywhere else on earth: 30 per cent more than a tropical seasonal/monsoon forest or temperate evergreen forest and nearly 50 per cent more than a temperate deciduous forest.

A semi-evergreen rain forest in the Ivory Coast has been found to produce twice as much carbon per hectare as a Danish beech forest and oxygen production would be correspondingly larger. But these figures refer to *gross* production, of which three quarters was lost in the case of the rain forest because it was burnt up in respiration, so consuming much of the oxygen (and carbon) which had just been produced. The *net* productivities of the two forests were therefore similar, since the Danish forest was leafless for 7 months a year and had lower losses due to respiration.

The *net* production of the semi-evergreen rain forest does not mean that every year more carbon is locked up and more oxygen added to the atmosphere, as this 'extra' carbon is used to replace the wood of trees etc. which have died and been decomposed to carbon dioxide again by forest organisms. The tropical rain forests are climax ecosystems which have reached a state of dynamic equilibrium after evolving for over 30 million years, so their net productivity every year (after respiration has been taken into account) is sufficient to match the loss of carbon from the standing crop owing to death. As there is no increase in the amount of carbon stored in the forest, there can be no increase in the level of oxygen in the atmosphere.

The rain forests do not in fact contribute much if any oxygen to the atmosphere other than that which they themselves consume. Their destruction would not therefore affect the *supply* of oxygen to the atmosphere and this conclusion is now generally accepted by forest ecologists.[136]

**Burning the Forest**

Since at least half of the wood contained in the tropical rain forests is burnt when the forests are destroyed the other possibility which must be considered is that the tremendous amount of carbon which they contain (41 per cent of all carbon stored as land vegetation) will use up so much oxygen when it is burnt that there will be a significant decrease in atmospheric oxygen levels. (Fig. 19).

Fig.19: **TROPICAL RAIN FORESTS CONTAIN OVER 40% OF ALL CARBON STORED AS LAND VEGETATION.**

| | Carbon stored as vegetation per square kilometre of various biomes (gmsx10 ) | Carbon stored in vegetation in various biomes as percentage of all plant carbons |
|---|---|---|
| Tropical Rain Forest | 20.2 | 41.5 |
| Tropical Seasonal Forest | 15.6 | 14.1 |
| Temperate Evergreen Forest | 15.8 | 9.5 |
| Temperate Deciduous Forest | 13.5 | 11.4 |
| Boreal Forest | 9.0 | 13.0 |
| Woodland | 2.59 | - |
| Savannah | 2.8 | - |

If *all* the carbon stored as vegetation in tropical rain forests were to be turned into carbon dioxide the world oxygen level would not be reduced by more than five parts in 10,000 or 0.05 per cent. This figure is of the same order of magnitude as one obtained by a similar calculation quoted in the UNESCO Report.

Originally there was no oxygen in the atmosphere and over billions of years the carbon dioxide which was formerly present in great concentration has been split up — the carbon locked up in various ways on the earth and the oxygen given back to the atmosphere. We only have oxygen to breathe because of that locked up carbon: 20 million billion tonnes is in the form of sedimentary rocks like chalk and 40 million billion tonnes is in the deep oceans either as sediments or dissolved carbon dioxide. Sedimentary rocks alone contain 2000 times the amount of carbon still waiting to be burnt up as fossil fuels and over 24,000 times the mass of carbon in all the earth's vegetation,[137] (Fig.20).

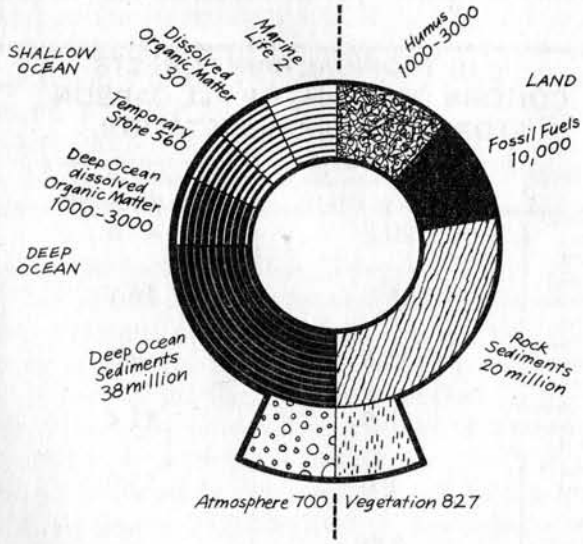
While these huge carbon banks remain intact the

atmospheric oxygen level is fairly secure, but there is one imponderable. If the rain forests are removed the soil becomes exposed to the hot sun and this oxidises the thin layer of humus as well as metal ions if the soil turns into laterite. No one has yet calculated how much oxygen *these* two processes would use up.

Fig. 20: **DISTRIBUTION OF CARBON IN THE BIOSPHERE. Amounts in billion metric tons of carbon ($10^{25}$ g.)**

*Source:* Woodwell, *Scientific American* 1978
Bolin, *Scientific American* 1970

The vegetation on the Earth stores a similar amount of carbon as is in the atmosphere as $CO_2$. The main carbon stores are rock and ocean sediments which are far greater than fossil fuels and vegetation in terms of quantity.




# The Carbon Puzzle

But this is not the end of the story because climatologists are far more concerned at what will happen to the carbon dioxide which is being added to the atmosphere after forests are destroyed. Carbon dioxide is like an atmospheric household tissue, soaking up heat on its way from the Earth's surface into outer space and causing a rise in average global temperature.[138]

Professor William T. Matthews of the Massachusetts Institute of Technology has predicted that if the present carbon dioxide level of 330 parts per million were to be doubled, the atmospheric temperature would rise on average by 2°C. The polar ice caps would melt, releasing more water into the oceans and thereby raising ocean levels and flooding large areas of low lying lands all over the world.[139]

Higher temperatures could cause even more carbon dioxide to be released from the oceans and so an irreversible chain reaction could ensue, but it is likely that increased cloudiness would counteract the warming trends eventually and as more land that was previously forested turns into desert the amount of dust in the atmosphere increases and causes a cooling effect as it reflects incident solar energy.

At the moment there is widespread confusion about just what is happening to all the carbon dioxide which is being expelled into the atmosphere by the burning of fossil fuels. Between 1958 and 1976 atmospheric carbon dioxide increased by about 5 per cent but the annual addition of 2.3 million billion tonnes of carbon was less than half that which was being produced by fossil fuel combustion and oceanographers could not explain how the seas were absorbing the remainder.[137] (Fig.21).

One team of American ecologists who had been investigating the possibility that the forests were acting as a sink for the extra $CO_2$ found instead that deforestation might be releasing perhaps twice as much $CO_2$ again into the atmosphere as was fossil fuel combustion! This makes the carbon puzzle even more intriguing.[137]

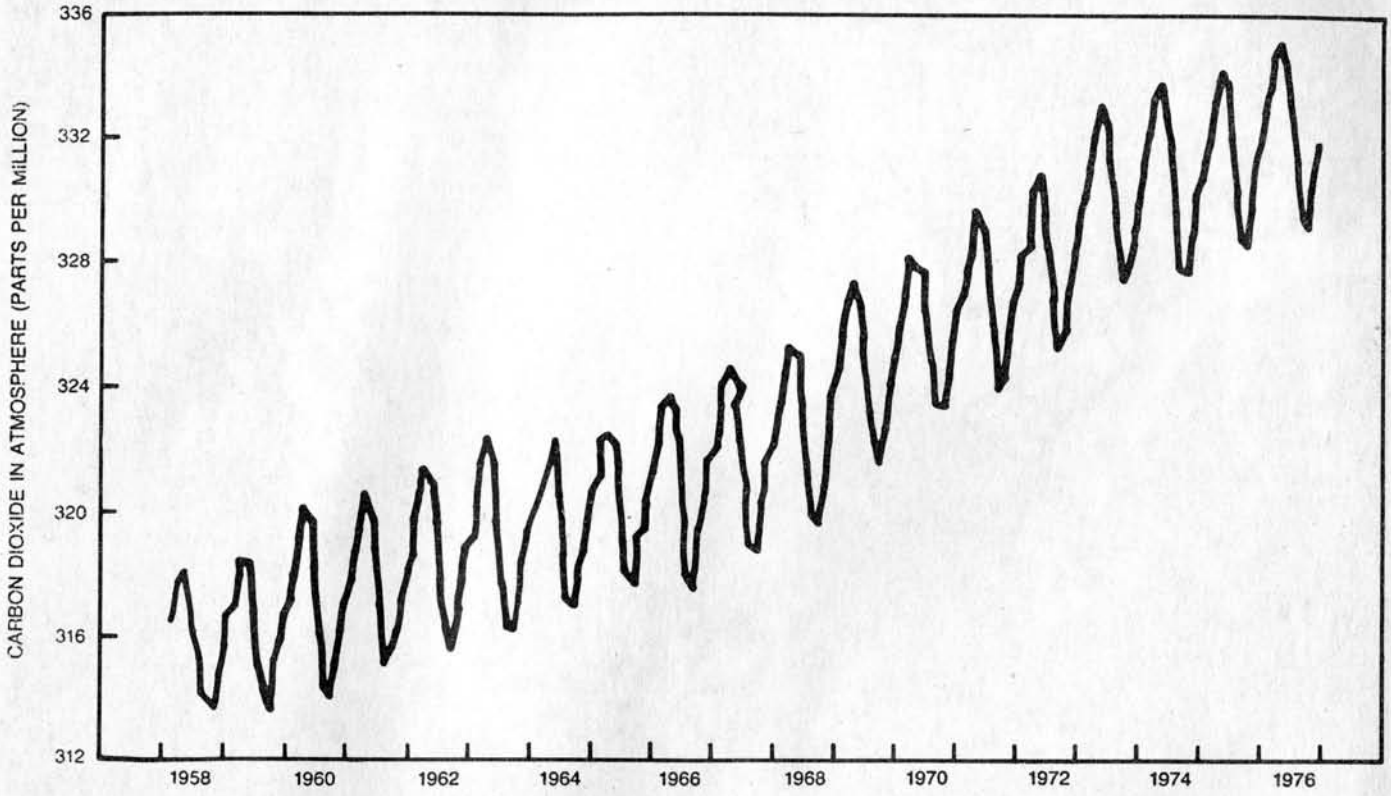
As far as climatologists are concerned, Professor Hubert Lamb has reported a definite increase in global average temperature since 1880 until the mid 1940s when it had climbed to 0.45° above the 1880 level. But since 1950 the Earth has in fact been cooling down. Records from the late seventeenth century indicate that the warming trend had started before the Industrial Revolution began pumping $CO_2$ into the atmosphere and certainly the continuing rise of $CO_2$ release today does not seem to be having much of an effect.[140] (Fig.22).

It is widely believed that this global cooling is an indication that we are moving into a "mini ice-age", and some delegates at the U.N. World Climate Conference held in the spring of 1979 considered that $CO_2$ induced global warming (labelled the "Greenhouse Effect") could gradually take over after such a cold interlude. Deforestation and fossil fuel combustion will probably tail off by the year 2020 and so the future is relatively uncertain.[112]

John Gribbin thinks that trends towards greater extremes in the climate could be a far more serious result of the "mini ice-age" than global cooling.[141] Following the Indian floods of 1978 came the drought of 1979 and in both cases large quantities of crops were lost. Brazil's coffee plantations have been hit by frosts in the 1970s, with an estimated 6 million bags lost out of a projected 1979 harvest of 26 million. Oil palm plantations throughout South East Asia have also suffered because of drought.

We don't understand what is happening to all the $CO_2$ we are expelling into the atmosphere, nor can we predict the likely climatic side effects. Once we are on this climate see-saw it could be very difficult to get off. Who knows how the changes in the global heat balance and water cycle are adding to greater climatic extremes owing to the "mini ice-age" and what part the increasing amounts of $CO_2$ and dust in the atmosphere are playing? What will happen when the sink, which at the moment is absorbing all of the excess $CO_2$, becomes saturated? Will carbon dioxide levels rise even more rapidly and how will this affect

Fig. 21: **RISE IN ATMOSPHERIC $CO_2$ (1958-1976)**
**$CO_2$ in the atmosphere is rising at 5 per cent every twenty years.**




**TREND IN ATMOSPHERIC CARBON DIOXIDE has been measured since 1958 at the Mauna Loa Observatory on the island of Hawaii by Charles D. Keeling of the Scripps Institution of Oceanography. The Mauna Loa measurements and those made elsewhere show that the average carbon dioxide content of the atmosphere has risen more than 5 per cent since 1958. Rate of increase has varied from year to year from causes not yet known. Current rate is one part per million per year, equivalent to $2.3 \times 10^{15}$ grams of carbon.**

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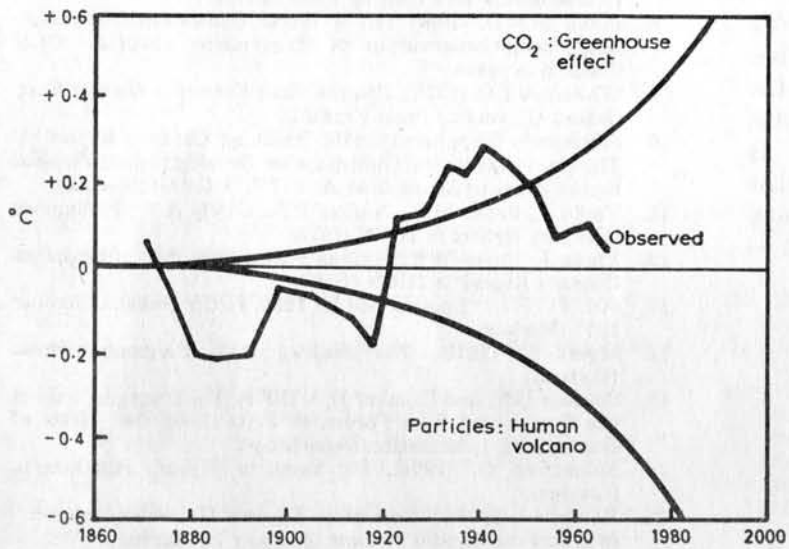
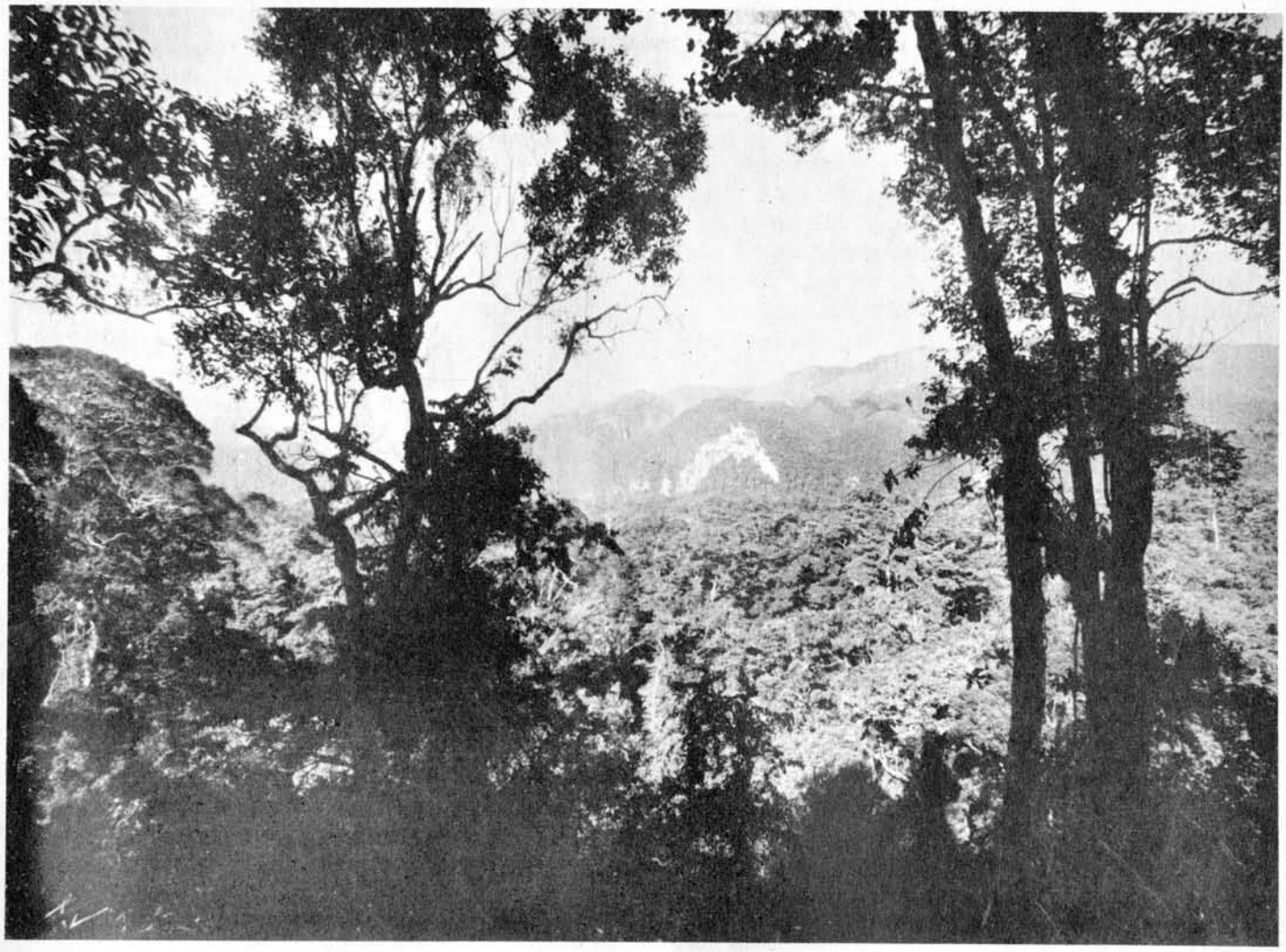
Fig. 22: **EXTREME INFLUENCES ON WORLD CLIMATE OWING TO HUMAN ACTIVITIES.**

**The Earth is cooling down at the moment, not warming up, but our activities are exposing the atmosphere to both warming and cooling forces. The result could be greater variation between climatic extremes.**




**How are Man's activities affecting climate? The $CO_2$ greenhouse effect (top line) tends to warm it: the emission of dust (bottom line) tends to reduce it. The observed variation in temperature may mainly be due to natural causes, but by the year 2000 the $CO_2$ effect is expected to have caused significant warming.**



the "mini ice-age"?

The investigation of mechanisms for $CO_2$ storage must be given top priority at UN level, as must research into the value of forests for local, regional and global environmental management. There are signs that deforestation *is* causing a breakdown of environmental maintenance, and when the forests go the environment and soils which would allow quick regeneration to balance rises in atmospheric $CO_2$ are severely affected. One of the key future roles of forestry could be in the maintenance of the global carbon and heat budgets.[142]

It was Ehrenfried Pfeiffer who said: "The forest is the source of all life. When a culture reaches maturity and becomes over-ripe, it must return to the forest in order to rejuvenate itself. If a culture sins against the forest, its biological decline is inevitable."[143] Our sentimental attachment to the forest should change to one of rational respect, and alienation should be translated into brotherhood — before it is too late!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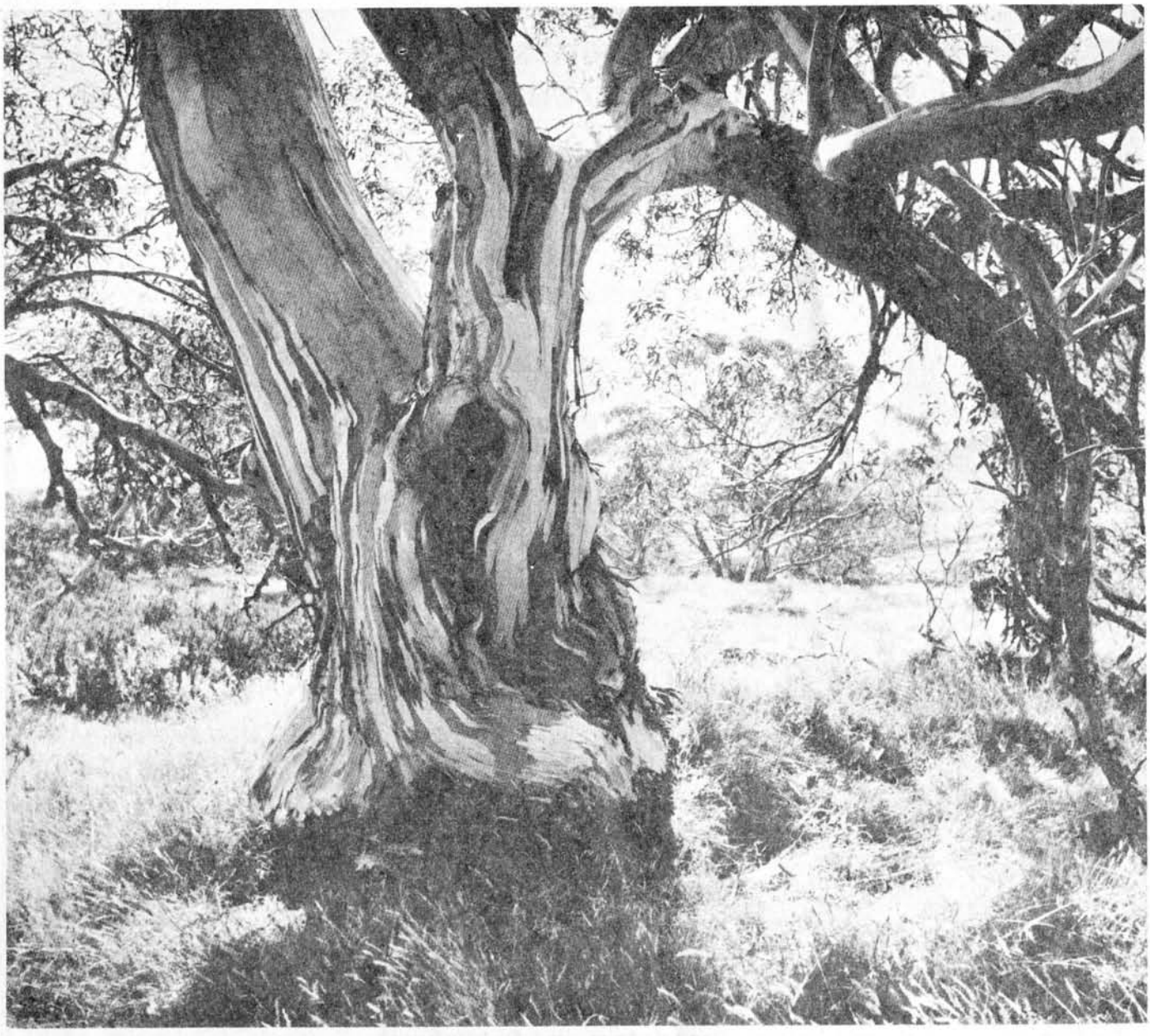


# Destructive Forestry in Melanesia and Australia

by Richard & Val Routley

Recently there has been growing awareness of the tragedy of world-wide destruction of tropical rainforest, which is correctly perceived as one of the saddest legacies our generation will hand on to the future. There is a very widespread view, however, of tropical rainforest destruction as an unfortunate but inevitable outcome of population expansion in the tropical parts of the developing world: rainforest, we are often told, is being destroyed to make way for beneficial development or because the hungry peasant does not care about tomorrow and cannot afford the luxury of concern about the fate of the forest. While this view may account for some tropical rainforest destruction in some parts of the world, it is not a correct explanation for the current destruction of the bulk of the world's tropical rainforest. The population explanation seems, in fact, to be a way of avoiding facing up to the real reasons for most rainforest destruction, which must very often be sought in the rapacity of the developed world and especially in the commercial operations it spawns in developing countries, as well as in the advantage of the ruling elites of developing countries which benefit from rainforest liquidation in many of the relevant areas. That the bulk of current rainforest destruction is neither an inevitable result of population expansion nor a process of real benefit to the bulk of the population affected has been forcefully argued in the case of another major area of tropical rainforest destruction, that of Amazonia (see Goodland and Irwin 1977). The thesis is perhaps even more strikingly illustrated in the case of Melanesia, and especially Papua New Guinea, where to a substantial part of the population affected the process is not a welcome development, and is being resisted.

# The Australian Scene

Examples of destructive forestry which is neither forced by population expansion nor of benefit to the bulk of the population are not unfamiliar from the developed countries themselves. Good examples may be found adjacent to Melanesia, in New Zealand and in Australia. Australian forests, like those of Melanesia and many other parts of the world, are now being seriously affected by factory forestry, by the burgeoning timber export industry, especially the woodchip industry, and associated replacement of natural forests by plantations. Over the last decade woodchip export projects, adversely affecting more than 2 million ha. of forest, have been established in southern Australia, and more are in the pipeline. In this period also forest management has become a major conservation issue and a major source of confrontation between conservation groups on the one hand and the alliance of forest services, industries, and professional foresters on the other.

Australian forests were a small proportion of the land area before European settlement, but since that time have been reduced by two-thirds and now constitute only 5 per cent of the land area. The clearance, in the course of development, of many of the best forests — for example millions of acres of magnificent mountain ash forests in Victoria — to create marginal farming land now too often bracken covered or eroded, has come to be recognised as a tragic error. Australian forests are now seen by many Australians as highly valuable, not just as a source of cellulose, but also for protecting native wildlife and flora, for maintaining recreational opportunities and the beauty and character of the landscape, and for protecting streams and watersheds.

But many Australians fear that the industry is destroying the non-wood values of public forests, and that it may even be helping to destroy the long-term capacity of the forests to produce cellulose. Like the softwood plantation industry, the woodchip industry has given a great impetus to 'tree farming' operations on the forests. These involve large-scale clear-cutting, and frequently the replacement of naturally occurring associations by planted or seeded monocultures of species more useful for wood production. The diversity of the natural forest, its wildlife and flora, and its scenic and recreational value, are all too frequently lost or greatly reduced in these operations. They can also involve serious consequences for watersheds, stream fauna and fisheries, through erosion and increased turbidity of streams, lakes and estuaries. There are also good grounds to fear that on many sites at least, soil fertility is being reduced through erosion and nutrient drainage, that yields will not be sustainable, and that the lack of diversity of the resulting even-aged stands will make them more susceptible to fire, insects and disease.

### A Public Liability

Australians are also concerned about the economic basis of this industry. Environmentalists have for years drawn attention to the considerable body of evidence which, despite the confidentiality of much data, suggested that the cost of regenerating the new forests exceeds the returns obtained and that the woodchip industry is a public liability. A number of more recent studies and reports have confirmed this picture, and have shown that Australians are indeed subsidizing the big pulp and paper companies (often foreign controlled) both through the low prices charged for the raw material, and in other ways.[1]

This fits in with the general economic picture for forestry. Generally the production of raw material is the unprofitable part of production, the highly profitable operation being the manufacturing part. When both operations are run by the one operator, a highly profitable amalgamated operation commonly results. But when the raw material production part is run from public forests at public expense, and the manufacturing part is in private hands, the picture is quite different. The profitable part is in private hands and the unprofitable and risky part is publicly borne. Forest services, which make large annual losses, are thus in the position of socialising losses for the large forest industries. Not surprisingly, this situation suits these industries well, and they are attempting to persuade governments to take over more and more of the job of producing their raw material, with some measure of success. The upshot is not only that forest industries are subsidised by the public, and wasteful and damaging excessive consumption of junk paper items — the major part of paper consumption — be encouraged, but also that the excessively low prices paid for raw forest material do not cover the cost of environmentally satisfactory forest operations or the cost of proper renewal of the forest. Environmental degradation is therefore encouraged.

### Who Benefits?

On the public side of the ledger then there seem to be largely costs. The public is losing financially; wildlife, wilderness and much that is valuable is being destroyed; and the amenity and diversity of the forest is being lost. In the woodchip case the resulting products, which for the most part make no useful contribution to people's lives, are exported to benefit overseas consumers. There are, on the other hand, substantial benefits for large pulp and paper companies, which are among our worst polluters. It is no wonder that increasingly people are beginning to question the benefits they derive from such an industry and to ask some awkward questions about the distribution of these benefits, and the real contribution the industry makes to the quality of their lives.

On the wider political and ideological level, Australian environmentalists are concerned about the narrow and excessive orientation to wood production on the part of Australian forestry services, and their preoccupation with industrial growth objectives. They are concerned about the scanty research undertaken

before enormous areas are committed to tree farming, the heavy promotion by forest services of these programmes, and the playing down of their serious costs and risks. Australian forest services, they believe, are oversensitive to the needs and interests of big industry, which has far too much influence on planning and decision making. Forest services are hostile to environmentalists but have close connections with industry and consider their interests as against those of other groups. They promote the tree farming programmes, which suit industrial interests, and attempt to obscure or deride alternative ways of managing the forests. There is suppression of information, secrecy in decision making and lack of public participation. Much of the destructiveness of Australian forestry can be traced directly to the over-whelming commitment on the part of forest services to the interests of big wood based industry, which interests dictate the large-scale mass production forestry, and the heavy handed, capital intensive, factory style operations that are so destructive of forest values.

# Throwaway Rainforests: The Melanesian Scene

The people of Melanesia have at least as much reason for concern about their forestry operations as Australians, especially about 'total logging' operations, which appear to be forestry of the most destructive sort.

The general outlook for Melanesia if recent trends continue is for liquidation of all accessible lowland rainforest by the year 2000. In Fiji extensive forestry operations are proceeding on the main forested islands and all useful timber with diameter in excess of 33 cm is being extracted; no attempt is made to regenerate the original forest.

> "The policy, based on the known slow growth of indigenous forest and its heterogeneity of species . . . is to regard the natural forest as a wasting resource and to plan to meet . . . requirement(s) from plantation." (USP n.d.:l)

In the Solomon Islands extensive operations in the rainforest are expected to consume the known timber resource in 20-30 years. The regeneration alternatives being considered are restricted to monocultural plantings over a small part of the cut-over area, and there is no attempt to manage or sustain the natural forest. In New Caledonia and the New Hebrides the little natural forest of commercial value that remains will be exhausted in the next thirty years. And in Papua New Guinea a number of large-scale export-oriented forest projects are predicted to make 'the lowland rainforest as a feature of Papua New Guinea . . a passing one' (White 1971). Apart from a number of smaller timber leases, woodchip projects are already operative in Madang in New Guinea and Open Bay in New Britain. Some five further large-scale integrated woodchip projects, and four others of intermediate scale, have been advertised (White 1975). These will affect most of the accessible lowland rainforest by the year 2000. A similar fate can be predicted for West Irian.

**Rush to Destruction**

The more detailed picture is no less depressing. The 'rush to destruction' of the natural forests is perhaps nowhere more conspicuous than in Fiji, where

> "the Forestry Department believes that earlier exploitation of the indigenous forest down to 3 ft 6 in. girth (about 13 inches diameter) is very desirable, plus a maintenance of the present very active plantation programme." (Lembke 1971:57)

According to A.K.Oram, who bore the somewhat inappropriate title of 'Acting Conservator of Forests',

> "The balance of advantage would appear to be strongly in favour of felling and selling as much as possible. If it were possible to do so efficiently it is arguable that it would be desirable to fell all of the natural timber over say the next 5 years. (Oram n.d.:4)"

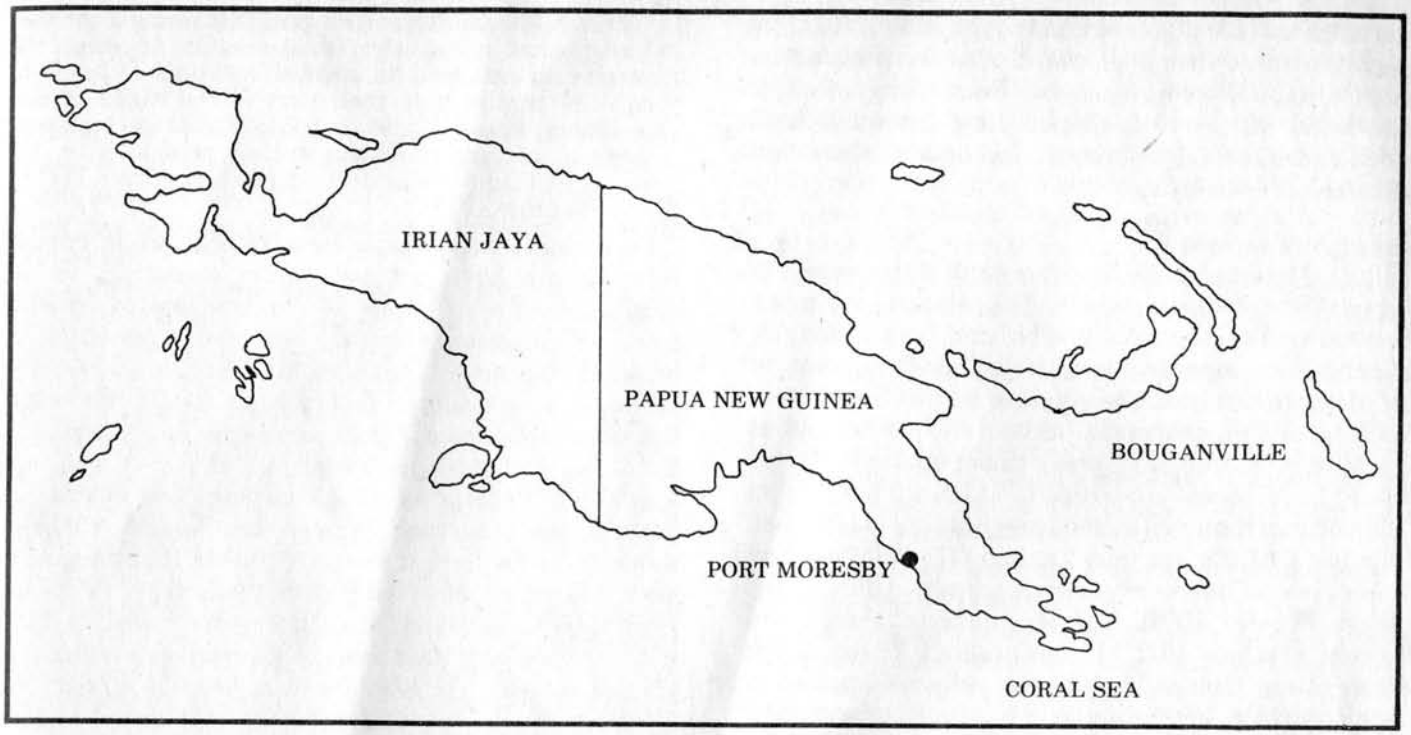
Since such a procedure is admitted to be practically impossible, Oram suggests "a compromise between the theoretical desirability of felling the entire resource now and what is practicable having regard to harvesting and marketing constraints" (Oram n.d.:4). The compromise strategy is to spread out liquidation of the indigenous forests over the next 20-30 years (cf. Lembke 1971:59). All the major areas of forest on the main forested islands of Viti Levu, Vanua Levu, Kandavu and Rabi have already been allocated to concessions, with the exception of an area in central southeastern Viti Levu which is probably being held as a future woodchip concession, and it is proposed that "Pressure should be exerted on existing concessions who are not fulfilling their minimum cut conditions". At the same time, to further the strategy, "Maximum encouragement in the form of taxation allowances (i.e. accelerated depreciation allowances) and import duty reductions should be available to this industry..."(Oram n.d.:8). In contrast, environmental constraints, which might reduce incentive, are definitely not encouraged. The result is that total logging of the natural forests (down to 33 cm diameter trees) - which will involve virtually complete site disturbance and interference with remaining poles — will be scarcely less destructive of the forests than clear-cutting for woodchipping.

**Other Threats**

Indeed by no means all of the destructive forestry in Melanesia will be for woodchips; so far, though destruction of forests has been extensive, only two woodchip schemes, both in Papua New Guinea, have begun operations in Melanesia.Total logging for veneer logs, saw logs and pulp logs, logging that takes all trees above a certain small diameter and results in almost complete disturbance of areas logged, can be just as destructive of the rainforest as total logging for woodchips.

In New Caledonia, only

> "10 per cent of the land is covered by natural forest.




This forest is receding as a result of bush fires and of mining exploitation and prospecting. It includes many species, but at present only about ten are known and exploited. . .

"It is estimated that the high forest resource (such as it is known at present) will be exhausted in 30-40 years time." (USP n.d.:2-3).

In the New Hebrides

"High forest is seldom developed due to cyclone damage, shifting cultivation and paucity of species. It is unlikely that stands of timber which would interest a large scale commercial exploitation exist except on Erromango where they are at present being exploited. . . .

"On Erromango a French Company 'Société Agathis' has begun a considerable operation to cut *Agathis* but this will probably not continue beyond 1976 by which time all the good logs will have been cut." (USP n.d.:6;; cf. also Anglo-French Condominium 1973:37-8).

In fact the company, which had a licence "to cut an unlimited amount of timber", ran into difficulties and export tonnage fell to a fifth of earlier levels in 1974. The Solomon Islands has, like Fiji, pursued the British colonial strategy of rapidly liquidating the natural forests for what they will fetch.

"The tracts currently under commercial plans will last about 10 years and then other areas would be called upon to play their part. These, it is estimated, will last a further 20 years — 30 years in all . . . . It can be seen that the regeneration programme in the BSI must be given a very high priority as the present cutting programme will consume all the known resource in 30 years." (Lembke 1970:46)

Fortunately this programme — to cut through all the natural rainforests of commercial importance at a rapid rate, and to replant very limited areas with short-rotation monocultural plantations directed primarily at the production of pulp — has run into substantial local opposition. The opposition is effective, since approximately three-quarters of the country's remaining commercial timber forests are on customary land. In the view of the industry-forest service alliance

"the first and most urgent problem is to secure cutting rights so that the present timber industry can continue when the present tracts are worked out in a few years time." (Kera and Maenu'u 1975:5; cf. also Lembke 1970:48)

At present remaining forests in the Solomons

"are reserved 'to meet the future needs of existing operators' . . . the timber industry is fast approaching a stage where it needs positive assurance of future log supplies in specific areas if it is to continue development . . . . There can be no doubt that the industry will not be prepared to implement any large new investment programme except on the basis of full security of raw-material supplies." (Lembke 1970:48)

The timber operations are entirely foreign owned and controlled, and most of their production is shipped to Japan. As we shall see, the local people are receiving little benefit and incurring many costs for the sale of their lands and forests. It is not surprising that they have objected, and that

". . . the landowners did not want to sell more lands to the Government. . . . The . . . last try (at a) system (of agreement) is already showing signs of the landowners disliking it. In any case it is doubtful if this system gives sufficient security for the timber company's investment. It remains very important to work out what will be *the* correct system that the landowners will agree to *so that their forests can be worked so as to be of great benefit to them and their Government.*" (Kera and Maenu'u 1975:5; our italics)

Really, as in other parts of Melanesia, the main benefits accrue to foreign companies, to Japan, and to a small government elite.

In Papua New Guinea, where the pattern of distribution of benefits and costs is similar, there are likewise difficulties arising with the traditional owners of the lands. The most conspicuous example is the way in which the Binandere community succeeded in preventing two major foreign companies from exploiting forests in the Northern Province

(documented in Waiko's excellent paper 1977). There is a real prospect then that *the distinctive Melanesian pattern of land tenure*, so far from being a major drawback, will serve in Papua New Guinea also to block undesirable development and be *in the interests of nature conservation.*

**Papua New Guinea**

By far the largest and best forests in Melanesia lie in Papua New Guinea, which has almost as much forested area as Australia, and in Irian Jaya. Substantial concession areas in Papua New Guinea are now up for offer. Apart from the projects in the Gogol (near Madang, with a concession area of 67,000 ha) and at Open Bay (183,000 ha) already taken up, major forest areas have been advertised at Sagarai-Gadaisu (120,000 ha), Kaumusi (85,000 ha), Kapiura (83,000 ha), Kapuluk (181,000 ha) and Vanimo (278,000 ha). And 'other areas of intermediate scale promoted during this period *included* Kaut, Tonolei Harbour, Hargy and Bakada'. (White 1975:11; our italics.) These larger Papua New Guinea operations will be liquidation logging: they are designed to cut through the productive forest in the concession area in a fixed time (typically 10-15 years). A further 800,000 ha of forest is committed under log and sawmill concessions. These concessions, some of which are large, are likewise far from benign. (See, e.g. Jonas 1972. Some of the remoter operations, for example in the Nothofagus forests of the Highlands, are also apparently very damaging.)

D.McIntosh, then Director of the Department of Forests, Papua New Guinea, recognised some of the dangers of the environmentally and socially disastrous large-scale log export projects that are proceeding in adjacent Indonesia and southern Philippines:

> "We believe, however, that it would be wrong to allow this (i.e. large log export operations) to happen in Papua New Guinea. *Log export operations*, because of the nature of Papua New Guinea forests, *yield minimum returns to the country and move through the country at a great rate, leaving behind a degraded forest and a multitude of roads* and tracks to be quickly overgrown." (McIntosh 1971; our italics.)

Surprisingly, McIntosh thought that these wrongs would be rectified with large-scale integrated (log and chipwood) export industries, which subsequently, possibly, involve pulp mills. For such integrated operations, which characteristically involve clear-felling, if anything increase environmental degradation (and, as will become apparent, returns to the country are not much better than minimal). For

> *"The clearfelling of large annual logging coupes will oblige the Administration to mount a massive reforestation programme. It is believed that in general, secondary growth will have little potential even for pulpwood and therefore plantation forestry will be necessary."* (Endacott 1971:59; similarly White 1976)

**Industrial Forestry**

Of course the massive reforestation programme (which could be avoided in a modest programme with careful selection removal or small patch cutting) suits the industrial orientation of the Department of Forests:

> "It is only then (after 100 per cent removal of the forest) that we can get down to the business of producing cellulose on a short rotation. Only then can the tropics play their part in the world forest products scene (Colwell 1971:39), as a biomass factory of enormous potential productivity in respect to timber and derived products (from Webb and Higgins 1978)."

Fortunately many major forestry schemes in Papua New Guinea have not yet begun operating, for a combination of reasons — in particular, world economic recession, affecting forest import industries in the developed world; the availability, at give-away prices, of more uniformly marketable rainforests, with but few environmental or other requirements imposed and practically none enforced, further north in Indonesia, Philippines and Malaysia, and nearer to main Asian industrial regions. The respite will not however be for long it seems. Projects that have not been taken up have been readvertised, with more favourable terms. And the rainforest further north will not last very long (less than 20 years) at present rates of exploitation, e.g. 600,000 ha a year in Indonesia. Logging concessions 'fill the maps of Sumatra and Kalimantan to saturation', concessions have been sold in the Celebes, which is now being logged, and in some outer islands, and West Irian is 'in the process of being carved up' (Jacobs 1978: *Flora Malesiana Bulletin* 31:3020ff.) The readily accessible rainforests of northern Philippines have been largely exhausted, at great environmental and social cost, and Mindanao is now being exploited. The lines of forestry exploitation converge on West Irian and Papua New Guinea.

**Indonesia**

The botanically and ecologically unknown rainforests of Indonesia's largest province, Irian Jaya, are not to escape damaging exploitation. Attempts have been made to sell large logging concessions ever since integration with Indonesia,[2] and recently are beginning to meet with some success. It seems entirely unlikely that Irian Jaya will escape the Indonesian Government's policy of massive forest exploitation of the outer islands, and the simple and effective idea of environmental destruction as a tool of social change, or that the Melanesian customary land tenure system will be allowed to stand in its way.

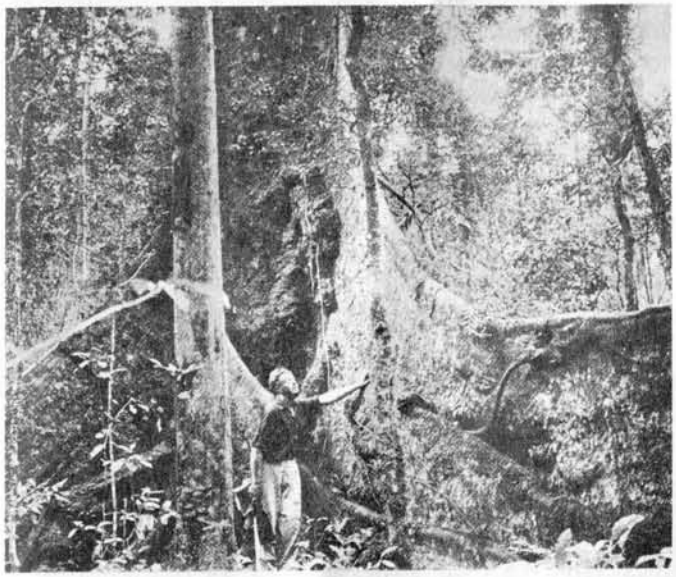
> "It was explained to me that an important feature of Government policy is to develop the 'outer' islands (i.e. outside Java). Forest exploitation is useful in this because large-scale mechanised logging has a substantial social impact . . ." (McKelvey 1974:8)

Finally, the exploitation and limited replacement of Melanesian rainforests will be increasingly directed to the production of low grade, and often undesirable, pulpwood products. Because of the diversity of species, rainforest material generally yields not high quality pulp suitable for writing paper, books, etc., but largely low quality pulp used primarily for packaging materials.

> ". . . indications are that the 'run-of-the-bush' mix is suitable at least for the production of packaging materials. This is confirmed by the Honshu Paper

Manufacturing Co. Ltd., which, if its project at Madang is successfully launched, does in fact intend to use its material for linerboard." (Endacott 1971:54)

Subsequent plantations of kamerere (*Eucalyptus deglupta*), at Madang and elsewhere, will not produce high quality pulp, either, but primarily material for junk products. In this sense the rainforests are truly throwaway.



Buttressed Moreton Bay Fig found in Tropical Rainforests.

## Likely Effects of These Schemes

We take as our discussion example the 'showpiece' Madang project, which is only the first of a series of projects 'about to lay waste' vast areas of accessible lowland rainforest in Papua New Guinea (Womersley 1974). This project, as presently planned and conducted, gives every sign of becoming an environmental disaster. The project is employing large-scale clear-felling in a valuable and fragile ecosystem, one far less resilient under this type of treatment than the temperate forests in which this controversial practice was developed.

The Madang project did not from the outset meet an essential minimal condition for any non-destructive forestry operation, that of providing adequately for the regeneration of the forest, or at the very least for some other productive use (See Webb 1977). There was no evidence that the deforested land would, except in a few parts, be suitable for alternative agricultural ventures, and there is now evidence that it is unsuitable. Nor is it exactly news that primary tropical rainforest will not return on a short-term time scale, if at all, after large-scale clear-felling, and that widespread loss of forest is likely to occur. Rainforests are generally not stable under substantial interference of the sort that total logging operations impose, or even under various selection systems. There are several reasons for this (see, e.g., Gómez-Pompa *et al.* 1972 and Meijer 1975), e.g. the short viability and short dispersal range of the seed of most primary rainforest trees, the susceptibility of rainforest seedlings to ecological disturbance, especially to fire, the loss of nutrient capital. There is a far from negligible probability then that much of the forest area will become an eroding and impoverished wasteland. It is the same elsewhere in Melanesia and Southeast Asia.

> "A common pattern in (these) countries . . . is for a small part of an exploited timber concession to be developed for agriculture and another part, favoured with convenient location and topography, to be planted to exotic plantation. But always an area, usually the major part, is left fallow and relatively unproductive." (McKelvey 1974:5)

To a large extent, then, the Madang project appears to be a deforestation exercise.

> "The logging scenario eventually adopted was devoted almost entirely to the requirements of wood harvesting, and was based on an (ecologically) unacceptably narrow definition of environmental constraints and conservation requirements." (Webb and Higgins 1978).

The effects of deforestation of hillsides in the humid tropics are only too well known — erosion, continuing landslides and landslumps (evident in the Madang project), increased silting of streams and estuaries, and increased downslope flooding with adverse consequences for adjacent productive areas, yet a considerable proportion of this deforestation programme affects land that would by most standards count as rugged; half is hilly with steep slopes. The project does not meet, either, the important requirement that in tropical and sub-tropical areas with high isolation at least 30 per cent of the land should be left under forest cover to protect soil and water.

The actual commitment to reforest even part of the deforested area appears to be quite vague, and there were conflicting claims about who will undertake it.[3] In general in Papua New Guinea wood export contracts "the commitments on both sides, Government and entrepreneur, are vague" (Carson 1974:5). Carson's claim is said to be readily confirmed by anyone with access to these confidential documents: the contracts are wide open, in far too many respects (except as regards public scrutiny).

### Loss of Wildlife

Replanting with short rotation tree crops, even if it were successfully carried out over a large area, would renew only the cellulose producing properties of the forest. The loss of other valuable non-wood aspects of the forest is no minor matter, especially in a country like Papua New Guinea where the forests are important to many of the people, and which has been described as having "for its size one of the richest, most diverse and most unique floras and faunas in the world" (Schodde 1973:123). In fact

> "The principal threat to the perpetuation of the native fauna of New Guinea is in the alteration of the environment and particularly the elimination of native forest. The latter is very important since a

major portion of the fauna is strictly limited to the forest vegetation." (Gressitt and Zeigler 1973:117).

The rainforests are, of course, the main habitat of this biota, with, for example, 75 per cent of birds being essentially rainforest forms, and 65 per cent of endemic birds being confined to *primary* rainforest. Even in the unlikely event that regeneration of secondary forest were to be obtained over a substantial part of the area then, the results of deforestation are likely to be severe. For, as Schodde has pointed out, the flora and fauna of the secondary forest — already widespread in New Guinea where rainforest has been disturbed — is relatively poor.

> "For example, a recent avifaunal survey of the Lake Kutubu area . . . revealed that out of seventy species of forest birds recorded, only twenty, all representatives of widespread New Guinea forms, were found regularly in secondary growth" (Schodde 1973:129).

Furthermore where a high proportion of the fauna is arboreal or dependent on the forest for shelter, even temporary deforestation can have severe effects.

Despite the high percentage of land area in forest, then, there is no ground for complacency about the effect of forestry operations on fauna, and certainly not for the complacency exhibited by the Forests Department — exemplified in K.G. White's (1975:13) pseudo-ecology: "The modified forest should be an improved habitat for ground fauna and for much of the bird life; it is possible that it could be more productive in this sense than the existing forest". Furthermore many of the areas to be destroyed are inadequately known botanically, thereby posing a major hazard for plant species (Womersley 1974). These areas include White's 'large resource of which we have a detailed knowledge' (1972:61).

Continued destruction of the rainforest habitat in the style of the Madang project will certainly result in massive reduction in numbers of non-human species, and also very likely in considerable species eliminations. Animal species at the end of food chains are, reportedly, already showing decline. It is thought that areas of 1200 ha of suitable type and shape are needed even for temporary holding operations, and considerably larger areas for permanently viable faunal populations. By these standards *the Madang project does not have a single adequate conservation reserve* for flora and fauna (in fact only about 1 per cent of the area has been so far reserved, and much of this is unsuitable). Where so much fauna has primary rainforest as its habitat, adequate reserves would be quite essential even if the natural forests were being managed and regenerated, which is certainly not the case.

**Future Jeopardised**

But it is not just the yield of forest values other than wood production that is in jeopardy — the sustained yield of cellulose itself is in grave doubt. It is intended to replace what is felled with short rotation monocultural crops such as kamerere (*Eucalyptus deglupta*), grown on 10-20 year rotations. Only someone with a highly overconfident view of the ease with which natural systems can be manipulated for human ends, who is prepared to ignore the conservation laws, or who has faith in the prolonged capacity of the soil to withstand abuse, e.g. by heavy steel shod machinery, can seriously believe that these short-rotation monocultural crops in the humid tropics will be permanently sustainable except under the most favourable conditions of soil with massive inputs of fertiliser. Even at present fertiliser prices, heavy inputs of fertiliser are likely to have a serious effect on what economic viability there is. The best soils are commonly already in demand for agriculture, and total logging concessions are frequently on inferior leached soils.

But it is not just short-rotation and soil fertility problems that constrain such replanting projects. As Lamprecht (1969) has claimed:

> "In spite of the enormous advantages (especially rapid growth and short rotations) which wood plantations have in the tropics and sub-tropics, indisputable proof exists that they lack biological stability."

Documenting the matter is not completely straightforward, since most plantations are fairly new, and forest services prefer to keep silent about failures. As Lamprecht goes on to remark

> "Lack of knowledge about large-scale damage in the tropics and sub-tropics does not mean that such damage does not occur. Visitors are usually taken to show-piece enterprises for obvious reasons. The same is true of the literature. We are not the only ones who prefer to keep silent about failures. And finally one should not forget that the majority of plantations are fairly new even when measured against the short rotations . . . usually less than 20 years."

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**Deforestation has caused erosion, landslides, silting of rivers and estuaries, and severe flooding . . .**

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Lamprecht illustrates several causes of instability: fire; insect infestation; fungal diseases and die-back; site deterioration, primarily through fertility reduction and damage to soils (e.g. nutrient losses, soil erosion, changes in soil structure). In fewer than twenty-five years of plantation experience in Papua New Guinea, all the problems Lamprecht cites have occurred; attacks by insects, fungal root rots, termite and weevil invasion, fire losses, longer term nutrient losses. Several of the problems have also emerged in the new plantations elsewhere in Melanesia, for instance, in the Solomon Islands insect problems have been so serious as to threaten the use of *Eucalyptus* in reforestation schemes (Macfarlane, Jackson and Martin 1976).

Given the serious ecological costs and risks, what are the economic rewards thought to be generated by the projects, and how are they distributed?

# The Economics: Who Benefits?

On a world level the destruction of tropical rainforests for the woodchip industry involves trading one of the world's most ancient, complex and valuable ecosystems for one of the most worthless human consumption ends. In the Papua New Guinea case for example, the 'low quality' woodchips from Papua New Guinea's irreplaceable rainforests will mainly go to produce low quality packaging materials. There seems little chance then of providing a convincing justification for the Madang project in terms of meeting important 'needs', providing important consumer benefits, and lifting consumer living standards. It will have to be argued that the process of converting 60 million years of evolution into worthless paper packaging, although intrinsically indefensible, creates, as a byproduct, wealth for the people of Melanesia.

However in Melanesia there appears to be exacerbation of the Australian case; namely widely distributed costs, as against a concentrated set of tangible benefits that accrue mainly to overseas interests and to a minute urban segment of local populations. In these circumstances, no matter how heavy the costs — and in total logging cases they are very heavy — a distinct political advantage lies with the beneficiaries, since they can readily quantify their benefits within the accepted commercial framework and since they control or can influence political decision-making. The way the cost and benefits are distributed is revealed in the Papua New Guinea case.

Projects such as the Madang project are uneconomic. Public revenue for sawlogs and chipwood does not cover the basic costs of management of the project and reforestation of *one-fifth* of the area cut.[4] Even so important costs are omitted. Furthermore, good management, which could *help* to make more carefully designed and modest projects environmentally and socially acceptable, tends to be expensive, and is in no way allowed for in royalties paid. There is typically an inverse correlation between project acceptability and net commercial gain; that is, the more acceptable a project is made the greater are the public losses.

Public losses are partly reflected in Government forestry losses, where expenditure substantially exceeds revenue, e.g. by about 3.4 times (in 1975/1976), K5.23 million as against K1.54 million. The pattern for Australian forest services has been for expenditure to increase far more rapidly than revenue with the advent and increase of intensive forestry practices. A similar pattern should be expected for the Papua New Guinea Department, and has been predicted by recent foreign advisers. Indeed it appears that a substantial salvage operation will be required if the Forest Department is to meet even part of its responsibilities to reforest cut-over lands.[5] It has been proposed, by FAO advisers, not only that soft loans should be sought from various international banks to help with reforestation, but even that a special tax should be levied in forest development areas on the local population to pay for the reforestation of their forests.

In the Solomon Islands the overall picture is similar. Forest service revenues only just exceed expenditure because regeneration is seriously lagging; thus "the Conservator emphasises that replanting has not yet been built up to a level to keep pace with exploitation" (*Commonwealth Forestry Review 51:273*). Total logging operations succeed in making the marginal return that they do only by neglecting regeneration. When *some* replanting costs are taken into account, expenditure considerably exceeds revenue.

**Operating at a Loss**

Two replies are commonly made to this sort of criticism, firstly that there will be benefits through taxation earnings on company profitability, and secondly that the projects, though they may operate at a loss for the first few years, will eventually become profitable. Firstly, as in Australia, so in Papua New Guinea, the companies involved usually pay no taxes.[6] Thus in 1978 none of the major foreign-owned timber processing operations appeared to be making a profit and some, such as the Open Bay project were in grave financial difficulties (Jonas 1979). Moreover any taxation revenue that did eventuate would be far outweighed by infrastructure costs. Secondly, there is evidence that the woodchip export projects will never become profitable in their project lifetimes (see Routley 1975, 1977).

**Sixty million years of evolution is being converted into worthless paper packaging . . .**

The upshot is this: the total logging export projects appear likely to operate at a substantial public loss. Apart from their environmental and social effects, the projects will serve as a drain on public revenue rather than increasing it; they will require funds that could be better invested elsewhere (that is, they have serious opportunity costs); and Papua New Guineans are doing what they can ill afford to do, subsidising large foreign-owned pulp and paper and lumber companies.

**One-sided Risks**

The one-sided nature of the risks involved in the projects is also conspicuous. The foreign companies involved are prepared to make only relatively short-term commitments even for reforestation and normally write off their investment, plant, etc., over a period of fifteen years or less. When a forest is liquidated

(in fewer than twenty years should the new crop fail or be made otiose by new technology), they can move on to a new source of supply or diversify into other areas. But it is the local people who will be left to live with the results of the exploitation.

From the point of view of the local people who sell the timber rights, it may be doubted that the paltry initial per capita sale price and the royalty price of apparently less than 5 dollars per head each year during the period of liquidation of the forest, provide adequate compensation for the hunting, fishing and other forest food and produce forgone,[6] let alone compensation to them and their descendants for the long-term degradation and likely, irreversible destruction of the forest and other adverse effects on their lives. It is hard to avoid the impression that this is an updated version of the traditional bead trade, which can be summed up in the magnanimous offer of the western entrepreneur: "You give me that worthless ton of ivory and I'll give you this immensely valuable string of glass beads." Nowadays, it seems watches and transistors substitute for beads.

There is a trade-off between commercial benefits and social and environmental costs to the Papua New Guinea population. The Madang project, for example, will provide revenue for the Government — the main reason alleged for its existence — only if no attempt is made to reforest even part of the area or to impose adequate environmental standards.[7] If projects are operated without adequate environmental safeguards, any wealth the project generates will be at the expense of local people. The project would, if conducted without adequate safeguards as a once only operation, *redistribute* wealth. It would evidently shift it *from* the local village population, to an urban, administrative and governmental elite. On the other hand, if it is conducted in such a way as to *reduce* these costs to local people, it is difficult to see that there could, under present financial arrangements, be any significant benefits to the government treasury.

### Growing Local Opposition

The bleakness of the economic and environmental picture suggests that the local opposition to such projects is well justified. In fact such opposition has grown in recent years as the damaging social and environmental effects of the projects have become clearer. In the Solomon Islands "the largest sawmill had to close at the end of the year (1976) because landowners refused to allow logging to continue at royalty rates previously agreed, and demanded vastly increased royalties" (*Commonwealth Forestry Review 56:189*). At Madang the attitude of local people to logging has 'changed considerably over the past few years' and become much more critical (see the 10 main points made by the People's Forum, in Webb and Higgins 1978). There is dissatisfaction with the procedures (e.g. the removal of the important timber Kwila, essential for villages for posts), the lack of wildlife refuges, the results (e.g. the land after logging often becomes muddy and swampy, unsuitable for crops), the effects on culture of total logging and the royalties, e.g. they should be paid to a central organisation rather than as individual handouts. To the extent of course that royalty payments are transferred to individuals, a previously communal resource is transferred to individual hands, which is part of the process of social destruction. The local people have also turned to direct action against forestry projects.

> "In the Madang area, ... villagers have taken legal action against the logging company which drove bulldozers over a traditional claypot source ... . They have also adopted direct confrontation tactics such as felling trees across logging roads and disrupting logging machinery. In Morobe Province villagers have pushed tractors into the sea, and at Baldo and Wau they are refusing to negotiate Timber Rights Purchases, thus forcing one major operation to work at less than full capacity" (Jonas 1979).

**Local opposition has grown recently as the damaging ecological effects of logging projects have become clearer.**

## Why Undertake Projects: What are the alternatives?

The Projects are promoted, both by people inside and outside Papua New Guinea, for general ideological reasons concerned with development. The idea that any exploitation of natural resources ('development') that is undertaken must always be beneficial, not just to the exploiters, but to most of those associated with it, may be discredited in theory, but it is extraordinarily hard to dislodge as a working principle. This attitude, especially on the part of westerners, is supported in the case of New Guinea by the use of the magic word, 'underdevelopment'. In many western eyes this automatically conjures up a picture of desperate deprivation and thus apparently justifies equally desperate and exploitative export development strategies. But the case for such a desperate strategy, if it exists elsewhere, certainly does not exist in Papua New Guinea, where according to one western economist:

> "The overall picture that emerges is that of a low income country in which virtually all of the population have as much food as they want, are housed adequately by their own traditional standards, and have ample leisure for feasting, ceremonial and other pastimes. It is an economy that is potentially viable and self-sufficient at a level of primitive affluence" (Fisk 1966:23).

### Cultural Imperialism

There are of course other motives and interests at work too. As local people are obviously beginning to appreciate, to a large extent 'development', at least as

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it has been conceived and executed in the total logging projects, is a facade for a number of interests. That such projects supplying cheap raw materials for export are greatly to the advantage of the Japanese and other foreign corporations involved in the projects hardly needs stressing. In the longer term the disruption of traditional society and of its subsistence base caused by total logging can be also a useful means of forcing the population into the industrial economy, and thus of making the substantial and coveted mineral and other wealth of Papua New Guinea available to developers under the kinds of prices and conditions they are accustomed to in the underdeveloped world. Thus although such development is presented by many western economists as a process of *expanding* choice for the people of Papua New Guinea,it seems rather to be part of a process of *contracting* choice, and in particular of removing the important choice of maintaining local independence and improved traditional life-styles.

Projects are also promoted by and in the interests of, the westernised governmental and administrative elites bequeathed by the colonial system. Government has of course a direct interest in obtaining revenue from the projects. But government project promotion and planning also appeals to a number of vague benefits such as increase in GDP and improvement in the balance of payments situation, which appear most likely to be of value to westernised and urbanised elites, who are of course the main consumers of imported goods. Indirect and employment benefits to the population at large appear to be negligible:

> ''The low labour coefficients for the timber industry in Papua New Guinea suggest that . . . direct benefits will have gone to the metropolitan owners of capital intensive technology, while any indirect benefits (e.g. spread effects from wages to labour and multiplier effects) must have been minimal,'' (Jonas 1979).

Much of the governmental argument for the projects appears to presuppose the desirability of western economic patterns and of setting up an indigenous entrepreneurial class, a class which such development strategies is supposed to help create.

An important role in the promotion of projects too has been played by western advisers, who have promoted the 'aggressive marketing' of the forests, usually without proper consideration of their renewability, or the social and environmental effects of projects. Responsibility here falls heavily on the World Bank, which until recently did much to encourage a get-rich-quick attitude to the tropical rainforests of the world and which recommended the Papua New Guinea forestry policy of aggressive marketing (see, e.g. White 1972:59), on the Australian Government, which accepted its advice, and on the FAO, which, often in co-operation with the World Bank, has done much to foster the projects.

A string of western advisers, often FAO advisers, have helped to plan and advance these projects, usually without insisting on sufficient safeguards. Many advisers have been professional foresters from America and Australasia, and they have essentially played much the same role in Papua New Guinea that they play in

their home bases, that of promoting large-scale, capital-intensive industrialised forestry projects oriented to the interests of large forest industries and the consumer markets of the developed world.

The local profession appear to have adopted a rather similar role. It is evident that the Department of Forests, like most of the visiting forestry experts, has fostered the projects and has tried to whitewash their deficiencies, failing to draw attention to the heavy costs and risks or to consider appropriately less destructive and industrially directed alternatives to the projects. According to the Department, forestry policy includes "the desirability of 'aggressive policy development' of the timber production potential"; and it is contended that strict application of the requirement of environmental impact studies "can well defer much needed investment". In Papua New Guinea and elsewhere members of the forestry profession thus appear to have failed to secure any proper environmental surveys in advance of the approval of major export projects, and to have condoned and helped plan projects that will be liquidating some of the richest and least known forests in the world for one of the most worthless and wasteful end uses — the junk paper and packaging industry.

**Western advisers have played an aggressive role in the development of the forests, often with little thought for their long-term future or for the social effects of their schemes.**

**Local Wishes: limited development**

It seems clear that local people do want some improvements to their life-style, and many would like to see improved access, improved opportunities for local trading and better community services. But it is equally clear that in seeking such limited development they are not seeking the kind of development which destroys the forests, destroys the traditional economic, social and cultural base and forces them into the industrial system as landless labourers, or which undermines local independence and local self-determination (cf. Waiko, 1977). They seek in fact the kind of development they can control for themselves, and which improves rather than destroys their ability to control their own lives. This is not the kind of development the conventional western expert-dominated system with its emphasis on large capital-intensive projects, seems to want to deliver. In forestry as in other areas such as energy and agricultural systems, the overwhelming bulk of the research and education effort goes not into development of appropriate smaller scale labour intensive systems oriented to needs and suitable for locally based socio-economic development, for improved subsistence life-styles, but into the large-scale environmentally destructive capital-intensive systems suited to corporate and state interests and designed for export to markets in the developed world. Research and assistance for the improved subsistence life-styles apparently desired by most of the people is thus largely neglected.

It is not of course a question of developing small-scale forestry alternatives for accomplishing the same extensive forest destruction as the large export and industrially-oriented total-logging projects. Some local forestry utilisation, appropriately controlled by local people and oriented mainly to local needs, no doubt would be required. Here smaller-scale alternative silviculture has a role to play in limiting the damage. Such silviculture would take only a small proportion of the forest at a time, it would leave adequate buffers around the small logged areas, and it would make proper provision for completely unlogged areas to conserve wildlife and flora. Local people have themselves expressed strong dissatisfaction with wildlife conservation measures in the Madang project (Gogol Council Statement, in Webb and Higgins 1978).

Despite the inevitability of some forest clearance and utilisation, it seems that the maintenance of most of the primary forest and its use in the traditional ways which have preserved it for millenia in balance with indigenous life-styles might well be consistent with the local people's aspirations for an improved subsistence life-style based firmly on their own culture, their own society and on local self-determination. That its maintenance is not likely to be consistent with much central governmental control or foreign corporation economic penetration of the area is abundantly clear. If many of the local people of Papua New Guinea and other parts of Melanesia can maintain their local independence and traditional communal land-tenure systems which give an unusually high degree of decentralised local control, there may still be a chance that much of the magnificent, rich tropical lowland rainforest of Melanesia will, perhaps almost alone of the once-extensive tropical lowland rainforest of South-East Asia, continue to stand into the twenty-first century.

*Notes and References*

This article is a condensation and updating of Routley, *The Fight For The Forests*. David Dumaresq helped with the research and production.

1 See, for example, *Financial Analysis*, Forestry Commission operations in Concession of Tasmanian Pulp and Forest Holdings - 1978. Forestry Commission of Tasmania, Hobart, (which concluded that 'revenues are insufficient to meet . . . management costs'); Hammond 1979a: 13 and 1979b).

2 For a brief early history, biased however in favour of indiscriminate economic growth, see Garnaut and Manning, 1974: 75-78).

3 In 1978 a joint reforestation company between the Government (equity 49%) and JANT Woodchip Mill was planned to be responsible for reforestation under the Madang Timber Agreement (NPEP 1978-1981: 136).

4 Details, given in Routley 1977, are confirmed by some recent information, namely (1) evidence of public losses on Australian export projects where higher royalties are paid and less expensive natural regeneration is used; (2) cost estimates for reforestation lead to higher figures than those adopted (see the final table of A.E. White 1975); (3) royalties did not attain the higher figures suggested (cf. Summary of Statistics 1975/76, Bureau of Statistics, Port Moresby, 1979).

5 Even at Madang reforestation is lagging; although 10,000 ha were logged in 1973/77, not much more than 1000 ha were replanted. In 1978 Government financial assistance was planned for salvage logging in the Gogol woodchip area, and for the joint reforestation company to replant 2,400 ha at Madang over 4-6 years. Elsewhere the situation is worse. At Open Bay, the government is to undertake studies and trials to establish the feasibility of replanting 10,000 ha to ensure future pulpwood supplies to operators in the area (NPEP 1978/81: 136-7).

6 The woodchipping company Harris Daishowa which operates out of Eden, Australia, claimed in 1971 (when the taxation argument was widely deployed in Australia) that the company would be viable by 1976. By 1978 it was still paying no tax. Nor is it ever likely to make a substantial tax contribution.

7 Work such as Liem 1977 makes a valuable start on furnishing details for such costings. For example, in the Garu area megapode eggs alone were estimated to be worth K3000 in one season (39,000 eggs at 10t each).


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# Nuclear Power in Eastern Europe

As the energy crisis grew, it was stressed time and time again that, in contrast to the west with its growing diffidence over nuclear energy, the Soviet-dominated eastern bloc was committing itself to a large-scale expansion of nuclear power, heedless of environmental considerations, of reactor safety and of ecology, and blindly indifferent to the possible consequences for millions living in central Europe.

Today, we are less sure. Consider a recent event in the Soviet Union. The Soviet Communist Party's theoretical journal, *Kommunist*, published a key article on the current nuclear programme by Academician Nikolai Dollezhal and economist Yuri Koryakin.

The authors argued that while the USSR could not do without nuclear energy, the large-scale construction of power stations in areas of high population density — in European Russia — would use up too much land and water and that the difficulty of storing nuclear waste would raise the possibility of dangerous radioactive leaks.

The article was interpreted by some western journalists as a sign that, despite official Soviet optimism about nuclear power, there were at least some doubts among senior Soviet energy experts about the wisdom of pressing ahead with nuclear reactors in populous areas.

**Nuclear Parks**

Dollezhal and Koryakin had put forward the idea of building nuclear power stations not individually, as at present, but in large complexes up to 10,000MW in which nuclear fuel would go through its entire cycle from enrichment to burning and waste disposal.

The day after the appearance of the *Kommunist* article, the official media in Moscow reported it briefly as a proposal by Soviet scientists. A week later it was announced that Teploelektroproyekt Institute was to design and Glavvostokenergostroy to build an atomic power station with a capacity of over 6,000MW at Neftekamsk, Bashkiria.

Referring again to the article, the report said that construction of atomic power stations in the USSR was being carried out at present in the European part of the country, west of the Volga-Baltic canal, where about 60 per cent of the population live, where most industrial and agricultural production is carried on, and where mass tourism is growing rapidly. The environment in European Russia, said the report, was increasingly regarded there as one for living in, rather than as a source of resources. In future, new atomic power stations would be located at a distance from areas of population and would be large complexes.

**New Thinking**

What the *Kommunist* article expressed was not merely the scepticism of a few officials about nuclear power, but a new policy on nuclear development, deeply influenced by a decade of thinking within the Soviet Union on environmentalist lines. The new policy clearly has the full backing of the Politburo.

The profound changes in thought and attitude implicit in this Soviet policy for the next Plan period have yet to be adequately registered in western countries. Yet the policy and other recent events indicate at the very least that, in spite of the extremely confident Soviet assertions about reactor safety in recent years, there has been increasing concern about safety and the environment both in circles of informed scientists and at the highest levels of state.

**Total Confidence**

In a polictical setting such concern is, of course, entirely compatible with expressions of total confidence. While Soviet officials were sharing their misgivings privately about reactor safety and nuclear waste disposal with their British counterparts at a joint energy symposium in Moscow this autumn, it was being said publicly that Soviet experts believed environmental protection problems could be solved "at any level of atomic power engineering".

The USSR was designing nuclear power stations of up to 6,000MW and "all such plants, among them those already in operation, are safe and reliable" — an accident could only happen once in 10,000 years.

**Accident in Finland?**

A matter of five weeks before the new policy was announced, sources in Helsinki were expressing grave concern over the possibility of accidents in the PWR at Loviisa. Latest safety checks had shown, the Finnish authorities said, that a possible fault in the cooling circuit could cause a serious accident.

Representatives of the Imatran Voima company went to Moscow in September for talks with the Soviet suppliers. On September 11, Jan Laaksonen, chief inspector of the Finnish Institute of Radiation Protection, said that while investigations into the PWR had already lasted five years, new aspects raised by the accident at Three Mile Island had been studied.

"Indications have been obtained only in the last few days that a possible leak in the cooling circuit could weaken the heat exchange taking place in the reactor", said Laaksonen. As a result, the protective cover of the uranium fuel might be damaged.

The possibilities of repairing the faulty pressure vessel were examined and slag seals in the corrosion resistant coating inside the pressure vessel were found to be responsible for the difficulties. Lovissa I's entry into service has now been delayed for over a year.

The significance of the problem at Loviisa is twofold. Laaksonen says the nuclear station has functioned very well so far and is of first-class international standard, so we are not dealing with a case of a standard-issue Soviet reactor gone wrong.

The problems lie in the containment vessel made by Westinghouse. The Soviet reactor would not normally have been supplied with this indispensable safeguard and it had to be requested specially by the Finnish authorities.

Thus at Loviisa we have a Soviet reactor that does not measure up to international safety standards, made "safe" by the addition of an American pressure-vessel that is faulty.

**Number of Reactors**

Varying estimates have been made of the number of standard 440MW Soviet Voronezh reactors in eastern Europe. A total of 26 in operation has been mentioned and one reputable writer, noting that "all nuclear matters are shrouded in secrecy", estimates 18 in operation at the start of 1979.

The Soviet authorities themselves give a figure of 12 nuclear power stations, with a 1980 target of 20. Since some units are up to 1,000MW

and counts are based on varying criteria, it would be reasonable to accept 18-20 as an accurate figure.

**East Germany; opposition growing.**

In East Germany, where secrecy is also said to reign, two stations (at Lubmin and Rheinsberg) are certainly operational. One of them (Rheinsberg) is currently of 80MW capacity. Expansion at both Lubmin and Stendal is planned and the technically-advanced GDR may be expected to move ahead very rapidly with nuclear power in the next five-year period.

A report this summer, published in the GDR, said that the country intended to secure the major part of growth in capacity for electricity production after 1980 through the building of nuclear power stations. These are likely to be sited in the north or in the border area, as far away from the major concentrations of population in Berlin and the south as possible.

There is, however, a growing body of public opinion opposed to nuclear expansion, and the problems of nuclear power are openly discussed. Recently, for example, the woman's magazine *Fur Dich* published a passionate article by a GDR woman journalist on the way the Rheinsberg nuclear station had destroyed the ecological balance of the beautiful Stechlin lake, north-west of Berlin, where the reactor is located.

More potent in its critical attitude to nuclear power is the Evangelical Church in the GDR. This is the church of the broad majority of church-goers and its influence, especially among the young, is growing.

Its good relations with the ruling Party have given its recent warnings over nuclear power a force that no dissident group could muster. Meeting in Schwerin this autumn, the evangelical synod called for a national discussion on the opportunities and dangers of the peaceful use of the atom.

The synod stressed the need to protect human health and the environment and spoke of the encouragement being given by the church to politicians, scientists and specialists within the church on responsibility for the future of mankind and the environment.

The church may, of course, be dismissed as an impotent body in a communist state. Even so, their attitude to nuclear power is in sharp contrast to that of their evangelical colleagues in West Germany.

**Czechoslovakia**

Turning to the remaining eastern bloc countries, note has to be taken not only of a common nuclear energy programme settled in Moscow and of common official attitudes to nuclear power, but also of a combination of remarkably diverse circumstances and an unpredictable variety of response to their individual national economic circumstances.

Czechoslovakia and Poland both possess substantial coal deposits and their dealings with nuclear power have been almost subsidiary to their struggles in recent years to improve the speed and quality of coal-extraction methods and machinery. Breakdowns have been frequent, partly because of old equipment and the lack of skill in dealing with new machinery.

Against this background of technical industries, it is astonishing not that there were two appalling accidents at the nuclear experimental plant at Jaslovske Bohunice in 1976 and 1977, but that there were not more tragedies.

Today, two years after the accidents were reported by Czech scientists to Charter 77 colleagues, the first 440MW block at Jaslovske is operating satisfactorily and the second reactor block is in the final stage of construction.

A second nuclear station is being built at Dukovany and a station at Mochovice is to come into operation soon. While two other nuclear stations are planned, progress at Dukovany is proceeding so slowly that their existence on the drawing-board is academic. A shortage of labour at Dukovany and the failure to find an operator for a railway spur leading into the site has created substantial delays.

**Massive Technical Problems**

The point that needs to be made in respect of these Comecon countries, given their current position, is that their present and future dealing with their own basic industries in no way suggests that their dealings with nuclear power will be more satisfactory.

This is not in any way to deride countries that contain men and women of the highest scientific distinction, managers of state enterprises of outstanding ability and so on. It is simply to underline the recent report of the German Institute for Economic Research.

This report concludes that whereas in the west resistance from environmentalists leads to the delays in building nuclear power stations, Comecon countries are struggling against shortfalls in their nuclear programmes because of technical difficulties.

These shortfalls do not reflect the lack of competence that helped to cause the tragedy at Jaslovske Bohunice. They reflect a shortage of skilled labour and, as the report notes, insufficient capacity in the engineering and ancillary industries.

**Programme Cut Back**

In 1971 the Soviet Union approved an expansion programme for nuclear power that envisaged additonal capacity of 30,000MW up to 1982, but this has now been reduced to 19,000MW by next year. However, only 10,000MW has gone into operation and even the reduced 1980 target is unlikely to be achieved.

The resulting picture — taking into account the delays already mentioned together with delays in Hungary and Romania — is that a total of about 12,860MW of nuclear power capacity has now been installed in these countries, of which 10,000MW is in the USSR.

**Growing awareness**

Delays apart — over which we may or may not indulge in *Schadenfreude* as we choose — there is the more positive factor of a growing awareness of the dangers of nuclear power. It is this, more than public opposition, which is likely to upset Comecon's nuclear programme. This year already, the Hungarian authorities have gone out of their way to stress the safety factors being incorporated in the nuclear plant under construction at Paks. This summer, the Czech authorities claimed that spending on overall protection facilities represented almost half the overall on-site costs of nuclear construction. Outside Comecon, but still in eastern Europe, the Yugoslav local populations are being consulted on the siting of power stations — and local protests have led to plans for a nuclear station on the island of Vir being abandoned.

This is little enough, but half a loaf is better than no bread. More than ever before, the governments of eastern Europe may be about to realise for themselves the truth of a brief poem by East German, Peter Huchel. "No-one", writes Huchel, "will enquire into a species eagerly bent on self-extinction".

*Peter Wood*

# Books

## Ecologists in a Distorting Mirror

SYSTEMS ECOLOGY by H. H. Shugart and R.V.O'Neill. Dowden, Hutchinson & Ross Inc. Pennsylvania. $29.50.

This is a collection of papers that have already appeared in various specialised journals such as *Simulation, The Journal of Dynamic Systems, Measurement and Control, Ecology* and also *Nature* and *Science*. If a technical appreciation of these papers is required then I am clearly the wrong reviewer as I am not at all convinced of the basic assumptions underlying the methodology these papers make use of and advocate.

The first thing that strikes one is the gulf that separates professional mathematical ecologists (with a small e) from Ecologists (with a big E) such as myself who regard ecology as an approach — one that basically involves looking at problems in their total temporal and spatial context rather than in isolation from each other as is currently the practice among most modern scientists. If one applies this approach then it becomes apparent that most of the problems that confront us today are due to the increasingly intolerable impact of our industrial activities on the ecosystems that make up the biosphere. Our first priority must be to reduce this impact and this means more than anything else moving away from expensive high technology to what is increasingly called alternative technology, better still to the full use of the far more sophisticated mechanisms of nature — such as those that enable forests to absorb $CO_2$, generate oxygen and control the run off to rivers.

The authors of this book see things very differently. They have in common with Norman Bell and Herman Kahn, a naive quasi-religious faith in the virtues of high technology which is irreconcilable with ecological understanding of the world we live in. Consider the following passage from G.M. Van Dyne's paper, "Ecosystems, Systems Ecology and Systems Ecologists". 'The role of computers in tomorrow's technology will have larger and faster memories, remote consoles, and time-sharing systems. Some may accept hand-written notes and drawings, respond to human voices, and translate written words from one language into spoken words in another. There will be vast networks of data stations and information banks, with information transmitted by laser channels over a global network.'

To me this statement sounds like a spoof on a technomaniac's recitation of his credo. What can all this gadgetry do for one? Very little I am sure as David Reichle and Stanley Auerback's paper "The Analysis of Ecosystems" makes fairly clear. They explain how essential is all this gadgetry for examining the changing land-use patterns in eastern Tennessee:

> 'A simulation model was developed based upon known plant succession for the region and land use trends derived from aerial photographs spanning 25 years. Predictions were made of the rates of change of various landscape categories for a five-county region. The rates of change for different vegetation types are related to the rates of plant succession and can be evaluated using empirical data from the field. The annual loss of non-forested land for the five-county area was 5.28 km² per year, of which 2.39 km² per year represented an increase in forested land (primarily due to the influence of a paper mill on the establishment of pine plantations) and 2.85 km² per year was irreversibly lost to reservoirs (TVA dams in the Valley) and urban development.'

In other words they are telling us that a vast academic study stretching out over twenty-five years and making use of incredibly complicated and expensive computers is required to tell you that the implantation of a paper mill is likely to lead to the development of tree plantations to provide it with its raw material and that the building of reservoirs will lead to the loss of agricultural land — a local shepherd could have given you the same information at the cost of a pint of beer in the local pub.

Another example is derived from the same paper. Reichle and Auerback tell us that:

> 'The conflict between demands for increased power production and improved environmental quality can be approached by integrating economic and ecological theory in a functional systems analysis. Consider the current problem of "blackouts" or "brownouts" in major cities as evaluated through a socioeconomic model by Chapman and O'Neill (1970). Intersection of the market supply and demand functions defines the market equilibrium, $Xme$, with price $Pme$. Environmental impact of power generation, as perceived by society, causes a new (social) equilibrium, $Xse$, defined by the intersection of the marginal social cost and marginal social value functions. Differences between equlibria create conflict between construction plans of power companies and conservation groups. At the total power production from plants actually built, $Xas$, the utility incurs market costs, $Cma$ The regulatory agency requires the utility to set its market price, $Pma$, at or near $Cma$. With price, $Pma$, public consumption demands quantity, $Xad$ which is substantially in excess of the amount, $Xas$, that can be supplied. This study illustrates how the energy production/utilization system is coupled in such a way that demand can exceed supply and cause brownouts.'

This example is just as laughable as the other. What on earth do we learn by being told that "blackouts" or "brownouts" will occur at 'the intersection of the marginal social cost and marginal social value functions.' Does it enable us to predict how much pollution has to be caused by the power industry before environmental groups start complaining or what pressure they are likely to apply to prevent any further pollution? It tells us nothing at all, it is just a pretentious and very clumsy way of saying nothing.

Having read this book I have to be persuaded that there is a single lesson of any real importance about

the behaviour of natural systems which can be derived from a computer study that a man of average intelligence will not be able to work out for himself. I am yet to be persuaded among other things, that quantification itself is of any usefulness for understanding the behaviour of natural systems. The editors inform us that mathematical modelling has been of particular use in the field of demography. This is no recommendation. Demography is a miserable subject. I have never heard of any demographer making an accurate forecast. In general, to determine the usefulness of quantifying the factors mathematical systems ecologists take into account, we must first determine what they are trying to achieve. According to Reichle and Auerbach 'the goal of ecosystem analysis is to develop a quantitative ecosystem science which may provide new theoretical insights into the organisation and function of natural systems at their most complex level.' But what makes the authors think that it is by measuring things that these new theoretical insights can be obtained?

The important factors involved in determining the behaviour of natural systems especially at a high level of organisation are usually non-quantifiable. Take the case of demography. What are the factors influencing population growth? It is certainly not the number of birth control devices that are distributed within a population, as most people in the population-control business still seem to think. Otherwise how do we explain that the population of France was stationary during the inter-war years when no birth control devices were available on the market? Nor is it protein availability, certainly if taken by itself, for hunter gatherers lived off perhaps 30 per cent of available food resources, so we are told, and their numbers remained constant for hundreds of thousands of years.

I think that it can be shown that the really operative factors are of a *psychological* nature. In France during the inter-war years people had a sense of responsibility and did not have children until they felt they could look after them properly. In North and Central Italy people still have such a sense of responsibility though not in the South where they breed like rabbits. If population growth has stopped in the West today it is probably also for psychological reasons. Attitudes have changed. Perhaps people see the future as being too bleak, which may be the reason too why population growth fell during the depression in the thirties.

Demography is not an exception in this regard. I think it can be shown that in almost every field of behaviour, the important factors involved are non-quantifiable. To insist, as our scientists do today, that only quantified factors can be taken into account, means that their attention has shifted from the study of important (non quantifiable factors) to that of trivial (quantifiable ones,) which is undoubtedly one of the reasons why scientists are not coming out with any of the answers to the problems that confront our society today.

My feeling is that if this book is a fair sample of mathematical systems ecology then this is a largely academic exercise of little interest to serious people who are trying to understand what is happening to the world around us with a view to offering serious workable solutions to such problems.

*Edward Goldsmith*

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**Learning for Life**

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RECLAMATIONS: Essays on Culture, Mass-Culture and the Curriculum by Peter Abbs. Heinemann Educational Books. £5.95.
NO LIMITS TO LEARNING: Bridging the Human Gap. A Report to the Club of Rome by James W. Botkin, Mahdi Elmandjra and Mircea Malitza. Pergamon. £6.25. Paperback £3.00.

It would be easy to dismiss Peter Abbs. For years now, in books and in *Tract,* the journal which, with unflagging fortitude, he publishes and edits, he has pursued his distinctive path: a lone advocate of education for the imagination as well as the intellect, urging, against the grain of a materialistic dominant culture, the importance of the qualitative as against the quantitative, of the expressive as against the functional. *Reclamations* offers more of the same. Where others might have given up, Abbs is still engaged in a struggle of his own choosing and definition, a struggle to establish, in education and in the broader — specifically, English — culture, 'the concept of wholeness, of heart and mind running harmoniously together.'

The problem is that, while he is clear on the deficiencies of mass culture, and of the philosophical tradition out of which it has sprung, and while he is eloquent on the subject of the alternatives which he would like to see instituted, it remains difficult to see how his proposals can be realised: they stand as ideals, without which, as he points out, advance beyond the *status quo* is impossible, but which nevertheless are no better than ambiguous, as signposts to immediate action.

For all that, it would be wrong to dismiss him. Those new to his writings will find *Reclamations* surprising and refreshing, as a voice in the wilderness always is; those for whom the freshness is at one remove can still be glad that the voice continues its civilised lament and passionate appeals, in a style fully consonant with its content.

To open *No Limits to Learning* is to enter another world: it reads as if written by a committee, for a committee. After an appraisal of the world problematique as a human challenge, it goes on to propose means by which the human gap — the gap between the rate at which the human environment is changing and the rate at which ordinary people are adjusting to these changes — can be narrowed: these proposals include the substitution of innovative learning for maintenance learning, problem clustering, anticipation, participation, integrative thinking, and aid for the Fifth World. From this tangle of words, a fair amount of common sense, unexpected perception, and conventional wisdom can be gleaned.

The starting point for the analysis is that, if environmental deterioration, nuclear episode, or social upheaval is not to render the planet uninhabitable, or at least to make existence intolerable, we must develop, as individuals and societies,

greater ability to predict, control, and come to terms with change: in the authors' terms, a capacity for innovative learning. Adopting a global perspective, the authors suggest how this capacity may be promoted, both inside and outside the developed countries. Their intention is to shift public attention from the material to the human factors which condition the future, and there is no doubt that they are well-intentioned: what is in doubt is the accessibility of their report.

*Bernard Gilbert*

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**Digging in**

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UNDERGROUND HOUSES; How to Build a Low Cost Home by Robert L. Roy, Oak Tree Press £2.95. THE DIY GUIDE TO NATURAL STONEWORK by J.A.C. Harrison, David & Charles, £5.95.

Robert Roy has developed, in a context of modern building techniques, an age old and potentially exciting method of housing, although he should have titled his book 'Underground House' as it consists of a detailed account of the design and construction of just one of these dwellings. However, as a source book for further work in this field, *Underground Houses* will prove very useful. Historically almost all underground dwellings have utilised sloping sites, but Roy's house is unusual in that it was excavated from an almost flat area, the spoil then being heaped around the finished structure to create an artificial mound and, practically more to the point, to increase insulation and protection from the elements, including those man-made. Unfortunately, for the practical reader the methods described are incredibly detailed, to the point of becoming tedious at times and I wonder if the ultimate success of the house as a low energy input comfortable home was *in spite* of leaving nothing to chance rather than *because* of it. Although an American publication the basic building techniques are relevant and include first hand experience of surface bonding blockwork, which is one of the simplest methods of block building developed in recent years, but a method which has had, as yet, little publicity. From his sub-title *How to Build a Low Cost Home* it is clear that Roy places considerable emphasis on this, but I would seriously question his claim of great economy, for his underground house; a lighter, very well insulated above-ground structure could compare favourably with the costings he gives at the end of his book.

J.A.C. Harrison's book is another which bids to encourage the amateur and although it covers the basic skills, it is rather simplistic in places. The author does admit this, and with his landscape gardening background clearly defines the limits of his work. He starts with a good basic introduction to the tools and equipment required and the main methods of finding and working stone and goes on to describe several types of walling, building pillars and simple arches, paving and a section on demolition and repair. He ends with the most complex projects; the construction of outbuildings for garden or utility purposes, barbecues, fireplaces and terraces. The tone of the book is one of gentle encouragement and it is clearly written. It should go some considerable way toward persuading many people to enhance their property, utilise an abundant resource and, after a litle practice, create something of lasting beauty.

*Trevor Lawrence*

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**Pollution-conscious**

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POLLUTION PREVENTION PAYS by Michael G. Royston. Pergamon Press, 1979. £10.00. Paperback £3.00.

Michael Royston's book is influenced by a sound integrated approach based on the view that pollution problems are best tackled by an appreciation of the total environmental system. The book is mainly concerned with preventing pollution by dealing with environmental causes rather than treating the pathological condition. Historical and cross-cultural examples are used to illustrate concern about pollution, its costs to the community and the growing social conflict resulting from it. A good deal of information is provided on the extent of government and industrial activity in dealing with pollution problems in both developed and undeveloped countries. In some countries, such as Sweden and Japan, it is claimed that pollution control policies in the early 1970s encouraged economic growth.

Much emphasis is placed on the commercial opportunities for developing pollution control equipment and 'non-waste technology', especially with the growing scarcity of raw materials and energy. One American company, Waste Management Inc., has already become a $250 million business with profits of around $20 m per year. Pollution control need not always be regarded as an economic cost to industry. Royston provides an interesting description of the 3M company and its 'Pollution Prevention Pays' programme, which provides the title for his book. The programme has four basic features: the reduction of pollution through product reformulation, through process modification, through redesigning of equipment, and through recovery of waste material for re-use. It is argued that too much emphasis has in the past been placed on controlling pollutants by converting them into something less harmful but useless. Instead greater effort should be made to reduce the quantity of waste by increasing process efficiency and recycling.

A good deal of the book adopts a conventional view of environmental improvement. There is, for example, a discussion of pollution control legislation, land-use planning, environmental impact assessment, pollution taxes, subsidies and other aids to industry. However, Royston appreciates the advantages of an alternative development path involving small-scale decentralized production which can make the best use of local raw materials. If this were to happen pollution problems could be more effectively dealt with at a local level, with decisions taken from the bottom up, by those who have to live with the consequences. In the final analysis, the move towards greater 'pollution prevention pays' requires initiatives from community, government and industry.

*Francis Sandbach*

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