

War and Forests: South Vietnam

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Vietnam has been under foreign domination for a long time. The Chinese occupied the country for ten centuries, and in 1862 Cochinchina became a French colony with the rest of Vietnam following in 1883. In 1943, with French permission, the Japanese came, to be followed again by the French in 1946 until 1954, at which time a partition of the country at 17°N was effected following a Geneva conference. American military advisers arrived in 1955, leading to a military build-up which climaxed between 1967 and 1969. These events, together with the strife before and after, mean that the country has been in a state of occupation or war for about 2000 years. Therefore it should come as no surprise that the Vietnamese army numbers amongst the four largest in the world and that a very strong sense of nationalism co-exists alongside economic chaos.

The reaction of many New Zealand foresters on learning that one of their kind has been working in Vietnam is to inquire about war damage to forests, in particular herbicide damage. The area where much of my time was spent largely escaped war damage. The Chinese incursions during the 1980 period did not reach that far south, while bombing during the American period did not extend that far north for fear of provoking an incident with the Chinese. However, I was fortunate enough to make several visits to the south and see some of the damaged areas and efforts to replace the forests. Quantitative data on the effects of war on the forests is difficult to find. Partly, this is because so little is known of the forest situation before 1960 and also because no full forest inventory has been carried out since.

In 1972, the University of Wageningen in The Netherlands commenced a study on the restoration of war-damaged forests in South Vietnam as a way of assisting recovery and rebuilding of Science and Technology in Vietnam.

This study drew mostly from published work, much of it carried out by the National Academy of Sciences by direction of the American Congress.

Much of the information in this article is drawn from the University of Wageningen report.

What I have attempted to do here is to describe some of the methods used to deny the Viet Cong the use of the forests, effects of these methods on the forests and recent attempts to replace the forests destroyed. Figures given in tables relate to South Vietnam as it existed before re-unification, i.e. south of 17°N.

Situation before the war

According to FAO, in 1955 about one-third of the country was covered by forests of economic importance which were classified into four types (Table 1).

TABLE 1:
Classification of forests of economic importance in South Vietnam in 1955

Mangrove	280,000 ha
Melaleuca	200,000 ha
Dense forest and woodland	4,275,000 ha
Pine forest	120,000 ha

At this time, 44% was considered damaged or depleted and of the remaining 56%, half was inaccessible. Thus only 1,400,000 ha was both economically accessible and in a good state. Some plantation development on a small scale had been started by the French.

War actions

In the early sixties, with overt intervention by the Americans, war strategy changed from conventional war involving anti-personnel and anti-material weapons which had proven largely ineffective, to include techniques causing environmental destruction through the use of anti-plant weapons. By these means the Viet Cong were to be deprived of cover, sanctuary and food. Control of the population was facilitated by strategic hamlets and refugee camps. The most frequently used new weapons and techniques were:

- chemicals (toxic gases, defoliants and rain-inducing agents)
- high explosive munitions
- bulldozing
- incendiary weapons

During the war, South Vietnam was divided into four Military Regions, each having "War Zones" and "Free Fire Zones". Heaviest action occurred in war zones 1 and 111. Chemicals used included anti-personnel toxic gases, soil sterilants, herbicides and cloud-seeding agents. Since the major part of the programme involved the use of herbicides, most of the discussion here relates to these. Military application was aimed at defoliation to improve observation and, to a much smaller extent, crop destruction. Agent Orange was most often



One-year-old *Eucalyptus camaldulensis* on disced mounds, Da Nang.

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used, representing about two-thirds of total volume sprayed with applications of around 28 litres per hectare. Most of the applications (95%) were from low-flying C-123 aircraft. Military use started in 1962, continuing until 1971. From 1970, the use of herbicides was rapidly phased out because of the clear superiority of the land-clearing programme, world-wide criticism of the herbicide programme and general winding down of US involvement in the war. Data based on a study of herbicide expenditures researched by the Committee on the Effects of Herbicides in South Vietnam are shown in table 2.

Between 1961 and 1973 a large number of high explosive munitions were thrown on Indochina from air and ground: roughly 50% by each means. From 1965 to 1973, 14,265 million kg were used and 10,176 million kg of this were used in South Vietnam. The major focus was the demilitarised zone, north of Saigon and the Ho Chi Minh trail.

Systematic land-clearing using D-7E Caterpillar tractors, armoured and equipped with shear blades or Rome ploughs, was introduced in 1965. Initially these were used to clear strips 100 to 200m wide each side of important communication lines. By mid 1968, organisation of machines into companies of about 30 machines for extensive forest clearing started. It became apparent that this means of area denial to the guerillas was in some ways superior to herbicide spraying. It has been estimated some 325,000 ha of forest (2% of South Vietnam) were cleared. The iron triangle north and north-west of Saigon in Military Region 111 was the heaviest concentration of this work. Attempts were also made in some areas to burn the defoliated forest but most attempts failed because of the high humidity.

TABLE 2: Herbicide spraying in South Vietnam from 1961 to 1971. All areas in ha x 10³

	South Vietnam		Inland Forests		Mangrove		Cultivated Land		Others		
A. Surface area (ha.)	17,429		10,400		288		3,120		3,626		
B. Total sprayed area	1,446		1,078		105		106		157		
% of A	8.3		10.4		36.4		3.3		4.3		
Number of sprayings											
	Area	%	Area	%	Area	%	Area	%	Area	%	
1	955	66	693	64	58	55	81	76	119	76	
2	324	22	251	24	27	26	17	16	29	18	
3	115	8	90	8	12	11	5	5	8	5	
4 or more	56	4	44	4	8	8	3	3	1	1	

Effects on forests

Most strongly hit were the moist evergreen forests in the northern part of South Vietnam, the moist semi-deciduous forests and the dry deciduous forests north and north-west of Saigon. About 1.1 million ha of inland forest were sprayed once or more. Of this, about 60% was located in Military Region 111. Spraying effects were dependent on vegetation type, number of sprayings, interval between sprayings, agent used, weather conditions and season.

The moist evergreen forests, moist semi-deciduous forests and montane forest are multi-storeyed, uneven-aged and often very rich in species – on average 100 to 150 different species/ha. After one spraying, all species drop their leaves within two to three weeks.

Resistant and partly attacked species will sprout again at the start of the wet season. Sensitive non-protected species in the canopy and upper stratum are killed. Generally, application of herbi-

cides has resulted in relatively large gaps in the canopy and stimulation of growth in non-attacked and resistant species. The most sensitive species in the canopy and upper stratum are: *Anisoptera* spp., *Lagerstroemia* spp., *Panodia cochinchinensis*, *Parinium* sp. and *Pterocarpus pedatus*. Less sensitive are: *Dipterocarpus alatus*, *Hopea odorata* and *Shorea cochinchinensis*. Among the most resistant are *Cassia siamea* and *Sandoricum indicum*. The improved light conditions after spraying and the higher degree of resistance of monocotyledons to the commonly used herbicides Agents Orange and White favoured the release and dispersal of bamboos. Table 3 taken from the University of Wageningen study shows the estimated mortality of trees after one or more sprayings in dense forest.

TABLE 3: Spray effects on dense forest

No. of sprayings	% of total sprayed area	% of trees killed outright
one	66	10
two	22	25
three	8	50
four or more	4	85-100

It was assumed by the Committee on the Effects of Herbicides that these closed forest types, after spraying once or twice, would restore themselves if sufficient regeneration was present. Three, four, or more sprayings favoured the extension of bamboo and Gramineae.

The hallier and thicket forest types consist of fast-growing, short-lived species which proved highly sensitive to herbicide spraying. Spraying of bamboo forest, while causing dieback of above-ground parts, had a very short-term effect because of sprouting. In these types, herbicide spraying probably led to an extension of the bamboo area.

The dry deciduous forests and open forest formations have a simple open structure with one or two tree storeys and after herbicide attack large gaps are formed which permit light to reach the forest floor more easily than in the more complex, multi-storeyed forests.

Damage from munitions exploding



Transport of *Pinus keseya* Da Lat.

includes direct destruction from the blast and from shrapnel directly severing the tree, or indirectly by causing wounds allowing fungi entry. *Dipterocarpus* spp., *Anisoptera* spp. and *Hevea brasiliensis* are particularly susceptible to the latter form of destruction while *Hopea* spp. and *Lagerstroemia* spp. are more resistant. Many estimates of numbers of trees destroyed by bombing and shelling have been made. They vary so widely that it makes little sense to present them all here. For interest's sake, one table prepared by Odum (1974) and included in the Wageningen report is shown below and estimates the area cleared by bombs on the assumption that one 500lb bomb clears an area of 730m².

and was aerially sprayed until the mangrove forests were totally destroyed. Between 1978 and 1981 the entire 22,000 ha area was replanted in *Rhizophora apiculata* using seed collected from the Minh Hai mangrove area further south. This was direct seeded into the mudflats at an intensity of 10,000 seeds to the ha. Form pruning and thinning are carried out to produce charcoal wood. 15 to 20 year rotations are anticipated with yields of construction wood as well as charcoal. Form and growth rates appear reasonable and the overall result very impressive. These areas are now being transferred over to Agricultural Enterprises for developing into combined shrimp farming and forest ventures.

niscent of the moon with large numbers of bomb craters and termite mounds covering otherwise flat and bare land. High current prices for export scrap metal have seen much of the shrapnel recovered, with people probing the areas around craters with spears to locate the steel. Reasonably large-scale planting of *Eucalyptus camaldulensis* and *Acacia auriculaeformis* is taking place. Establishment involves the use of 75hp Russian bulldozers to fill the craters and demolish the termite mounds, followed by two discings at right angles prior to planting. Some fertilisation is carried out and also mechanical weeding, where equipment is available.

TABLE 4: Vegetation cleared off by bombs (in 100ha), year by year for different land use categories (after Odum, 1974)

Land use		City land	Agricultural land	Forest land	Mangrove	Rest
Land surface in %		0.06%	17.23%	58.80%	1.60%	22.31%
Year	Total bombs					
1965	0.96 x 10 ⁶	0.5	120	400	10	?
1966	1.5 x 10 ⁶	1.0	190	670	20	?
1967	2.8 x 10 ⁶	1.3	360	1,610	30	?
1968	4.3 x 10 ⁶	1.9	540	1,860	50	?
1969	4.2 x 10 ⁶	1.8	530	1,780	50	?
1970	2.9 x 10 ⁶	1.3	370	1,250	30	?
Totals	16.9 x 10 ⁶	7.8	2,110	7,170	190	2,630

Total: 1,219,100 ha

Estimates of economic loss by herbicide spraying also vary widely and in many cases the distinction between merchantable and non-merchantable is unclear. The average estimate appears to be about 15 million m³, including both merchantable and non-merchantable classes. No figures for timber loss due to land clearing could be found. No doubt there exists a large element of double counting in some of these figures as many areas have been bombed, shelled, sprayed and land cleared.

Restoration

Because the number of sites visited was limited and facts are hard to find, some examples only of the plantation programmes are included here. With a bountiful supply of labour and a great deal of commitment, much has been accomplished. With the advent of the opening of a eucalypt chipwood export market to Japan, interest in establishing plantations is high, particularly in the south.

1. Mangrove forests

Duyen Hai District lies adjacent to and south of Ho Chi Minh city. Being so close to the then Port of Saigon and lying across the shipping routes, it was a favoured sanctuary for the Viet Cong

2. Grey sand soils

Much of the area immediately north of Ho Chi Minh city consists of plain topography of alluvial grey sands. The top soil is very compacted, but further down the profile clay content increases and the soil is more friable. Some of the most intense fighting of the war occurred in these areas and in places it is rather remi-

3. Sulphate acid soils

North west of Ho Chi Minh city can be found the sulphate acid soils in Hoc Mon and Binh Chamh Districts. These are perpetually wet organic soils supporting a mass of *Juncus* spp. on some sites and *Melaleuca* forest on others. Many of these areas form part of the new economic zones and development involves a massive amount of hand excavation to form planting mounds onto which pineapple and *Eucalyptus camaldulensis* can be planted. The oldest plantings on this soil type were seen at the Tan Tao research station where *E. tereticornis*, *E. camaldulensis* and *A. auriculaeformis* were performing well at age five years. By comparison, *E. brassiana* and *E. grandis* were not so good.

4. Dipterocarp plantations

Ma Da Enterprise is located north-east of the Ben Toa airbase and still retains most of its area under dipterocarp forest.



Hand digging of planting beds, Duyen Hai. Photo: M. Williamson.

Logging is a major activity, utilising old American equipment. *Tectona grandis*, *E. camaldulensis*, *A. mangium* and *A. auriculiformis* are grown. The fast-growing introduced hardwoods are looked upon as a means of providing short-term cash flow via the fuelwood and pulpwood markets. Most enthusiasm is reserved for *Dipterocarpus alatus* and *Hopea odorata* which they are attempting to re-establish following clear cutting by interplanting nursery-raised stock into a cover crop of *A. auriculiformis* which is progressively removed. The oldest such plantation seen dated back to 1982 with the *dipterocarp* varying between 2 and 6m in height beneath a scattered canopy of *Acacia* 15m high. A leguminous crop of *Indigofera teysmannii* is also being tried in association with the above species. 60-year rotations for the *dipterocarp* sawlogs are envisaged.

At the adjacent Hieu Liem Enterprise, capitalist experimentation with various types of joint ventures between the workers and the Enterprise management is being successfully tried. The annual planting rate is about 800ha. Individual workers retain ownership of the trees they have planted, with some returns paid back to the Enterprise in proportion to the inputs the Enterprise has supplied. Mixtures have been freely experimented with, as there is a high degree of consciousness of the need for long-term soil improvement. A mixture of 10 rows of eucalypt for pulpwood to one row of acacia was said to be best. Because of the shortage of State funds with which to finance forest investment, the joint ventures are being watched with a great deal of interest for possible application elsewhere. Also of interest is the pond full of crocodiles at the headquarters – a gift from Fidel Castro. The progeny of these must have found their way to Ho Chi Minh city, as the swimming pool at the Forest Research Institute was also occupied by these beasts. The significance of such gifts gives cause to wonder.

5. Pine forests

In the highlights above 700m a.s.l. *Pinus keseya* is managed as natural stands and as plantations. In the Da Lat area, 110,000ha of this species can be found. Protection from fire and shifting cultivation are the main problems reducing the success of re-establishment. Natural regeneration is good in most places and some very successful plantations were seen. On the low-lying country close to the coast from Da Nang in the south up to Ninh Binh in the north, *Pinus merkusii* is commonly grown. Or on area basis, this species, together with *E. camaldulensis*, would seem to be the most commonly planted species at present in Vietnam. The *P. merkusii* is



Five-year-old mangrove plantation, Duyen Hai District.

much troubled by fire, insects (notably defoliators and shoot borers) and weeds. The overall impression is that the success rate with this species is very low and from a timber-growing point of view one wonders why they simply don't give up and try something else less plagued with troubles. However, the timber aspect is very much secondary in their minds, as most of the value with this crop lies in the resin for which a valuable export market exists. After age 15 years bleeding can commence. Other species of interest in this area are *Casuarina equisetifolia* used for dune fixation and extensive early plantations of *E. exerta* widely planted before imported seed became more readily available.

International assistance in forestry

One cannot help but be impressed by the huge labour input applied to the plantation programmes. Much of this work is carried out by single women who keenly feel the war legacy of shortages of husband material, so necessary in this poor society where the family unit is the cornerstone to economic security. While much has been and is being achieved, other impressions are that a much greater degree of success would be possible if protection problems were overcome and planting programmes were based on better technical and economic bases. There is a great need for improved seed, more work into species and provenance selection and indeed establishment generally. The good work started by the French fell to a low level

on their departure, due to a lack of finance and capable substitutes.

After reunification, support was given by the Swedes in the north to a plantation project associated with a paper mill. Russia and some east-European countries have assisted with local and overseas training and indirectly through material assistance. A series of U.N.D.P. projects, often of a short-term nature, are a continuing feature. These usually rely on local Chief Technical Advisers who oversee a number of projects and are supported by a steady stream of short-term specialist consultants. Food support through the U.N.D.P. has also been invaluable in recent years to parts of central and northern Vietnam to alleviate famine and provide the quid pro quo for enlarged planting programmes which the State finds difficult to finance.

More recent arrivals to the forestry scene are the Australians, working through non-governmental organisations until the Kampuchea problem is resolved. They are located north-east of Ho Chi Minh city in the District where their army contingent was once based. The French are returning again, probably to Da Lat, and the Japanese are said to be investing in eucalypt plantations in the south.

References

"Restoration of war-damaged forests in South Vietnam" (1978). Published by the University of Wageningen, Netherlands. Volumes 1 and 11.