



Resource Management in Asia-Pacific

Working Paper No. 29:

Haumeni¹, not many: renewed plunder and mismanagement in the Timorese Sandalwood industry

Andrew McWilliam

Research Fellow,
Resource Management in Asia-Pacific Program,
Australian National University

¹ Meto Timorese word for sandalwood meaning 'fragrant wood'.

The correct citation for this publication is:

Author: Andrew McWilliam

Year of Publication: 2001

Title: Haumeni, not many: renewed plunder and mismanagement in the Timorese Sandalwood Industry

Series: Resource Management in Asia-Pacific Working Paper No. 29

Publisher: Resource Management in Asia-Pacific Program, Division of Pacific and Asian History, Research School for Pacific and Asian Studies, The Australian National University

Editor: Karen Fisher

Place of Publication: Canberra

ISSN – 1444-187X

Resource Management in Asia-Pacific

Working Papers

The Resource Management in Asia-Pacific Working Paper series seeks to provide readers with access to current research on environmental and resource issues in the Asia-Pacific. Working Papers produced by the Program aim to facilitate discussion and debate on critical resource management issues in the area, and to link scholars working in different disciplines and regions.

Publication as a 'Working Paper' does not preclude subsequent publication in scholarly journals or books, indeed it may facilitate publication by providing feedback from readers to authors.

Unless otherwise stated, publications of the Resource Management in Asia-Pacific Program are presented without endorsement as contributions to the public record debate. Authors are responsible for their own analysis and conclusions.

Resource Management in Asia-Pacific Program
Research School of Pacific and Asian Studies
The Australian National University
Canberra ACT 0200
Tel: +61 2 6215 9978
Fax: +61 2 6215 4896
Email: rmap@coombs.anu.edu.au

Haumeni, not many: renewed plunder and mismanagement in the Timorese Sandalwood industry

Introduction

There have been numerous occasions throughout history where the exploitation of a single commodity has transformed the fortunes of institutions, communities and even nations that have sought to benefit from its control. One only has to think of Middle Eastern oil, rubber from the former Belgian Congo or gold in South America to name a few striking examples. For the eastern Indonesian island of Timor, it has been the long-term struggle for the control and trade of high quality white sandalwood (*Santalum album L*) which holds this pre-eminent position. The history of Timor, for perhaps the last millenium, has been intimately bound up with the shifting fortunes of sandalwood production and trade. Over the centuries, the attraction of sandalwood and the fine scented oil produced from its heartwood, has encouraged an extraordinary array of diverse trading interests that jostled and warred for influence and a share of the lucrative profits from its exploitation and sale across Asia. For indigenous Timorese too, participation in sandalwood politics frequently lay at the heart of endemic struggles for power and wealth. The capacity to exert control over sandalwood production and trade from the interior of the island was a direct measure of political authority and standing among rival Timorese indigenous domains. To control the production and trade in sandalwood was to control the polity, at least as long as the situation remained uncontested. The converse also held true; namely that the holders of effective political power within Timorese domains were well placed to monopolise available sandalwood stocks. Thus to a significant degree the fortunes of Timorese society are mirrored in the history of sandalwood politics.

Like other natural resources however, the bounty that is sandalwood has its limits. While the heartwood of the tree has brought great wealth and riches to those dealing in its trade over the years, it has been achieved through uncontrolled plunder of available stocks. The history of sandalwood in Timor has been an exemplary model of natural resource destruction with little or no regard for long-term management and ecological sustainability. The consequences of this chronic neglect have lead Fox to argue that for Timor, 'sandalwood now stands as a symbol of its past not its future (1977: 73).²

A striking illustration of the contemporary situation in relation to sandalwood production and export, can be see in a recent report on trends in commodity exports from Nusa Tenggara Timur. It charts with an ironic absence of comment the drastic decline in the proportion of sandalwood production from the Province as a percentage of total exports. According to the official figures, the contribution of value added sandalwood products to export earnings declined from a substantial 30 percent in 1992 to zero in 1997.³

1992	1993	1994	1995	1996	1997
31.1%	15%	11%	3.17%	0.8%	0%

Source: Dinas Kehutanan NTT 1998

The figures reflect belated Government efforts to stem the widespread and largely unregulated harvesting of sandalwood stocks within the Province and especially across West Timor, which produces the majority of timber. A ban on the harvesting of sandalwood and strict controls on

² This situation is hardly unique to Timor, and unregulated sandalwood harvesting has threatened the sustainability of existing stocks in numerous places (e.g. Ramanathan 1997; McKinnell 1992; Monk 1997: 652)

³ Data Ekspor Daerah Nusa Tenggara Timur, Kanwil Dep Perindustrian dan Perdagangan: Kupang 1997: 3. I note that it is illegal to export raw or unmodified sandalwood timber and rootwood.

exports has officially brought sandalwood exports from the Province to a halt.⁴ For possibly the first time in the recorded history of the region, sandalwood no longer figures in export revenue from Timor. For Ormeling, who noted this declining trend over 40 years ago, the numbers represent a sorry contrast to the times when "open dumps of sandalwood covered a distance of a kilometre and more along the road to Kupang" (1956: 179).

Given this clearly pessimistic assessment of the state of the sandalwood industry in Timor, it is logical to conclude, as others have done, that the sandalwood resources in Timor are basically fully depleted with little or no hope of recovery. This is a view that has had its proponents over many years, and reflects a remarkably consistent and recurring perspective on sandalwood production from the Island. As early as 1656, for example, a Governor General of the Dutch East Indies Company (VOC) concluded that "in the Solor and Timor there is little for us to do in the future, virtually no sandalwood to negotiate, and more costs than profits to be gained for the Company" (cited in Fox 1977: 73). Admittedly these comments only reflected the depletion of accessible sandalwood reserves in the coastal areas controlled by the Dutch (Ormeling, 1956: 102). But from the middle of the Seventeenth Century sandalwood reserves across the island were already in decline. More than one hundred years later, the English Sea Commander, William Bligh, commented on his visit to Timor that "[t]he produce of the island is chiefly (s)andalwood and beeswax; the former article is now scarce" (1789 [1979] 241). Much later, Fox in his ecological study of Palm economies in the region also concludes that by the nineteenth and early twentieth centuries "...there can be no doubt that the major resources of sandalwood had been irreversibly diminished" (1977: 73). The pessimistic outlook is sustained by the end of the twentieth century when fears of an imminent collapse of the sandalwood industry were being expressed by business interests in Timor (Jakarta Post, 14 September 1996). The term '*di punahkan*' (wiped out) is now commonly employed to describe the situation. Thus, the history of sandalwood exploitation in Timor for the last few hundred years or so has been characterised equally by excessive extraction and by images of continuing or recurring scarcity.

Now, it is undoubtedly the case that the stocks of high quality Timorese sandalwood have been in long-term historical decline, and the prospects of returning to the situation that Portuguese traders in Timor faced "whole mountains covered in sandalwood" (Ormeling, 1956: 176) seem remote. Nevertheless, it is also the case that sandalwood exports have continued to flow from Timor for generations, albeit in gradually declining quantities. As evident in the official data (above) until very recently sandalwood has been one of the key export commodities from this otherwise resource poor island and a major contributor the regional gross domestic product of the Province of Nusa Tenggara Timur (NTT). The average contribution of sandalwood to Regional revenues for the Province of Nusa Tenggara Timur between 1992-1997 was 26.78 percent going as high as 43 percent in 1993-1994. (Udik, 1999: 3). Similarly, Government revenues from sandalwood for the period 1986-1990 averaged around 39 percent (Suripto, 1992). In these terms sandalwood has until recently represented a vital economic commodity for the region. Comparable figures for East Timor have not been located, but are likely to be somewhat less important to RDP but significant nevertheless. Officially reported average production of sandalwood (heartwood) in East Timor between 1990-1995 was around 124 cubic metres per annum (see Appendix 1).

In the midst of scarcity and diminishing numbers, mature stocks of sandalwood have thus continued to represent a major source of income for Governments, traders and rural communities alike.⁵ The key moderating factor in this equation is that sandalwood is an endemic species on Timor and continues to propagate naturally over wide areas of the island, particularly in areas of disturbed ground. In other words sandalwood is a finite resource at any particular moment but one

⁴ Some degree of inter-island trade in sandalwood is not officially reported. Indeed, arguably the mechanism of inter-island trade in sandalwood represents a strategy to subvert export restrictions. Similarly, export figures from east Timor are not included here but are likely to have been higher than officially recorded up until the withdrawal of the Indonesian Government in late 1999.

⁵ Sandalwood is reported to have a high fixative quality and in the manufacture of aromatic oils it has intrinsic blending properties and attracts a premium price in international markets.

that is naturally renewable with high rates of seed and root stock propagation. Comparatively small numbers of high quality mature trees can produce abundant quantities of seed and new vegetative shoots.

From seedling to maturing heartwood takes around one human generation and consequently it would be theoretically possible to regenerate extensive stands of sandalwood under the right conservatory circumstances. In the past, fluctuating market prices for the scented timber undoubtedly influenced the extent to which sandalwood reserves declined or regenerated. The practice of recurring plunder, a boom and bust cycle of harvesting, would have also led to fluctuating conditions of availability for the native timber which helps explain why the wood has for centuries been viewed as a scarce commodity yet continued to provide significant export revenue over the same period.⁶

In the contemporary context, as in the past, what limits further development and conservation of sandalwood stands has less to do with the bio-physical aspects of plant husbandry, and much more to do with the politics of control and effective regulatory conditions for managing the resource. In the following paper I explore some of these aspects of sandalwood politics and argue that one key problem facing the development of a sustainable sandalwood industry in Timor is the monopoly State control of the commodity itself. Unless and until the Provincial Government relinquishes and devolves its control over the diminishing resource there is little likelihood of restoring sandalwood to its central historical place in the economics of Timor island. In the absence of progressive policy change local farming communities, who have been the historical producers of the fragrant wood, will continue to be denied their rightful inheritance.

A short history of Sandalwood politics and indigenous Timorese domains

The intricate history surrounding the trade in sandalwood and the protracted struggles over its control among an array of trading interests has been the subject of a numerous detailed studies. Boxer (1947, 1948), Ormeling (1956), Schulte Nordholt (1971), Fox (1977) and Therik (1995) in particular have provided extensive accounts of this complex background, particularly from the viewpoint of external trade and its consequences. My intention here is not to reiterate these exercises but more to highlight the longer term consequences of these complex trading relations and sandalwood politics on indigenous Timorese domains.

Prior to the intervention of European colonial interests, Timor's reputation as a source of high quality white sandalwood was already widely known. Chinese trade in the timber is clearly of ancient duration. As early as 1436 a Chinese source states that "the mountains are covered in sandal-trees and the country produces nothing else" (Groeneveldt, 1880: 116). Chinese ships visiting the region had comparatively massive displacements of up to 1500 tons (Monk 1997: 651). Early Javanese and Sulawesi interests via Bugis and Makassarese traders were also well established by the time Portuguese and Dutch traders entered the region and established their presence in the sixteenth and seventeenth centuries. (Schulte Norholt 1971; Therik, 1995: 45-63).

Of the early pre-European sandalwood trading between Timorese and external trading interests, relatively little is known. Fei Hsin in his 1436 chronicle says of Kih-ri Ti-mun, (the Chinese Characters still used for Timor) that "there were 12 ports or mercantile establishments, each under a chief" (Schulte Nordholt, 1971: 159). Pigafetta, who landed on the north coast of Timor in 1522 aboard Magellan's boat, *Victoria*, provides somewhat more insight into the indigenous political order. He noted that:

⁶ It is widely accepted that sandalwood is an endemic species of Timor and the region and not an import from India as was once argued. (Van Steenis 1939).

On the other side of the island (there) were four kings, who were brothers. And where we were there are only towns and some chiefs and lords of them. The names of these kings are Oibich, Lichsana, Suai and Cabanazza. Oibich is the largest town.....All the sandalwood and wax which is traded by the people of Java and Malacca ⁷comes from this place, where we found a junk from Lozzon which had come to trade for sandalwood (Pigafetta, 1969: 141)

Pigafetta identified the southern central region of Timor as a centre for sandalwood and political power. The region corresponds to what Timorese oral tradition and the Colonial historical records recognise as the mythico-ritual Kingdom of Waiwiku Wehale. This domain is said to have represented the ritual apex of a complex confederation of Timorese political domains known by the phrase Liurai-Sonbai, that incorporated regions of west and east Timor (Fox 1992 and 1996; Therik, 1995). Under this reputed system, the political legitimacy of subsidiary domains rested on the spiritual hegemony and ritual authority of the Wehale centre. Although the structure and organisation of this mythical federation remains unclear, and some like Forman dismiss it as a fiction of Portuguese and Dutch historiography (1977: 100), it is evident that Wehale played an important role in sandalwood trade. Friedberg, for example, has argued that Wehale centrality in the political system was based on the "progressive control over the exploitation of sandalwood. The redistribution of Wehale wealth in the form of regalia (to lesser allied domains) would have been no more than payment for the sandalwood and wax delivered, perhaps in the form of tribute" (1978: 163).

Whatever the extant reality of the Wehale confederation it clearly represented a barrier to early Portuguese attempts to monopolise the sandalwood trade. In particular, an alliance with Makassarese sandalwood traders constrained Portuguese attempts to extend their trading influence (Therik 1995: 58-63). So much so that in 1642, the Portuguese under Captain-Major Francisco Fernandes accompanied by 3 Dominican Priests and 90 muskateers, marched from their base on the north coast of Timor and razed the settlement of the 'Great Lord', Nai Bot of Wehale (Fox, 1992; Leitao, 1948; Therik, 1995).⁸

This action succeeded in destroying the symbolic authority of Wehale and many leaders of vassal domains celebrated the victory and pledged allegiance to the Portuguese (Leitao, 1948: 207). It also ushered in a centuries long struggle for hegemonic control over the sandalwood trade involving a complex triangle of Portuguese and Dutch trading interests, as well as a myriad of indigenous Timorese domains which sought to benefit through political opportunism and strategic alliances.

The sustained historical interest exhibited by Colonial and other trading concerns in Timorese sandalwood underscored the very significant economic benefits derived from the trade. Profit was undoubtedly the driving force.⁹ At the same it is also apparent that the trade was a mutually beneficial one for indigenous Timorese communities, especially those who managed to bring significant stocks of sandalwood under their direct political control. It is true that the benefits of participation in sandalwood trading were not distributed equally, with the bulk of income and imported commodities accruing to the political leaders and petty Rajas. In one early report for example, Crijn van Raemburch (1614) wrote that

⁷ Malacca (Malaysia) was an important trading ports for Timorese sandalwood, a fact not lost on the Portuguese when they captured the port in 1511. In that year Albuquerque dispatched three ships to seek out the spice islands of eastern Indonesia including Timor (Therik, 1995: 47). The significance of Malacca to this region of Timor is recorded in the myths of the Sina Mutin Malacca (White China Malacca).

⁸ The immediate antecedent for this action was the punitive raid on the Portuguese trading entrepot of Mena on the north coast of Timor by the *Kreang* of Tallo in 1641 (Therik, 1995: 62).

⁹ Although precise figures on amounts are difficult to find. Van Leur estimated in 1614 that some 3000 pikul (1 pikul = 60kg approx) were brought onto the market each year. Cruwford (1856: 422) estimated the produce of Timor to be in the order of 8,000 picul. Moor makes the comment that the annual trade of Coupang which represented about 25 percent of the trade "has for the last 5 years exceeded twelve hundred thousand Spanish dollars" (1837: 3).

[O]n Timor in buying sandalwood one must engage in endless negotiations with the king and noblemen. The felling and transportation to the coast is carried out by the ordinary people. The greater part of the profits go to the rulers. (cited in Ormeling, 1956 : 177)

At the same time, given the re-distributive character of indigenous socio-political systems, and the need to maintain political alliances among the congeries of clan groups which comprised Timorese political domains, sandalwood benefits tended to be dispersed fairly widely. Kruseman (1835) observed that,

Nobody is permitted to cut sandalwood without an order from the Radja. The profits are divided so that the radjas receive half, the fettors and the cutters one fifth each, and the Temukung on whose territory the wood is felled, one tenth. (cited in Ormeling 1956: 177).

Opportunities for more individualistic sale and barter of sandalwood by local farmers seems also to have been possible, even within a system where the bulk of the revenues accrued to the political elite. In his early nineteenth century account, Moor (1837) provides an interesting insight into the dynamics of this trade at the time.

The [bees]wax¹⁰ and sandalwood, in the Coupang market, are generally brought by natives of Coupang from the south coast, in the months of December and January. The inhabitants of that part of the country are perfectly uncivilised and do not acknowledge the authority of any European Government.

The method of trading with them is very singular, as they very seldom exchange words....When the prows (boats) arrive off the coast, they land the articles they have for barter in small quantities at a time on the beach, when the natives immediately come down with the produce they have for sale and place it opposite the goods from the prows, pointing to the articles, or description of articles, they wish to obtain in exchange. (1837: 8)

The shifting and uncertain political climate of pre-twentieth century Timor also provided avenues for subsidiary political communities to assert varying degrees of autonomy from the ruling centre of the domain. One of the standard demonstrations of dispute or disagreement by allied subject communities was the withholding of annual harvest tribute from the central Ruler or Raja. While this action could well result in a coercive response from the centre, it nevertheless enabled local communities and subsidiary clan groups to enrich themselves and retain the harvest surpluses for their own benefit and that of their allies. A unique perspective of precisely this situation was documented by the anonymous Dutch writer 'D', who traveled into the mountainous domain of Amanuban in West Timor during the dry season of 1850. At the time a warrior clan of the Raja of Amanuban was asserting its independence from the Raja centre and a continuing state of enmity prevailed (McWilliam, 1996). 'D' recognised the place of sandalwood politics in this process. He wrote:

...[F]or many years sandalwood has been the main trade item from Amanuban and many thousands of *pikol* (bundles) of wood have been exported from here to China. Through this trade the population has become somewhat wealthy in a way which one does not find in other parts of Timor. Men and women and children are richly decorated with silver rings and plates and cloths and other types of European manufacture. Usually on Timor the sandalwood trade belongs only to the Raja as his monopoly...but here in this part of Amanuban that has split away..the whole population is gaining from this trade [paraphrased] (1851: 171-172).

This particular political community was unable to sustain its autonomy from the central Ruler and was eventually drawn into a re-united domain of Amanuban. It followed that most of the lucrative benefits of sandalwood once again flowed to the political centre. Nevertheless, the point remains that for varying periods in Timorese history leading up to the twentieth century, sandalwood production and the supply of the export trade provided a lucrative revenue base for indigenous communities. Benefits were manifold and included a whole range of exotic consumer goods including cloth, firearms and gold that underpinned local capacity to resist colonial control and

¹⁰ Beeswax was the second prized export commodity from Timor. In the nineteenth century there was high demand to supply the Javanese batik cloth industry.

sustain varying degrees of political autonomy.¹¹ In the shifting fortunes of the Colonial struggle for control over sandalwood trade and supply, Timorese political communities also derived a changeable but lucrative share.

From Indigenous Control to State Monopoly.

It is a remarkable fact that despite centuries of sustained attempts by Portuguese and Dutch Colonial interests to exert hegemonic control over the island of Timor, they were unable to effectively colonise the island until the early twentieth century. As Fox has noted, "for most of the colonial period, control was a matter of pretence and veneer" (Fox, 1999: 9). This extended to the control of sandalwood, which the respective Colonial administrations could only regulate from the point of transaction and sale. Production and ownership of the sandalwood itself rested with the indigenous leaders and populations of the hinterland. This was to change significantly when the Dutch Government, beginning in 1906, undertook a program of military pacification over the recalcitrant domains of west Timor and brought them under the administrative control of the *Pax Nederlandica*.

The subsequent history of the twentieth century to the present, has seen the gradual and inexorable erosion of indigenous control of sandalwood stocks and the transfer of ownership from the people to the State (Poffenberger, 1990: 19). This shift has been effected in stages; from the dominant position of multiple petty rajas and quasi independent political leadership of pre-twentieth century Timor, to the consolidation of political map under the Swapraja system of notional indirect (*zelfstandig*) rule, and the eventual introduction of the modern Indonesian State system.

In west Timor, the East Indies Colonial Forestry Service intervened initially through increasing regulatory supervision of sandalwood, eventually prohibiting the free cutting and sale of the timber in some areas by 1916 (Ormeling, 1956: 174). In 1925, the Dutch administration took direct control under the Sandalwood Ordinance (*Sandelhoutkeur*) which provided for a series of further restrictive regulatory measures. The Ordinance officially put a stop to unregulated cutting of sandalwood. It declared all sandalwood the property of the Swapraja with benefits from its sale to return to the community and required that all sandalwood permitted to be cut would be sold by public auction in Kupang (Ormeling, 1956: 175). In large part the ordinance was enacted to restrain what Ormeling describes as the rape of sandalwood during the period 1905-1915 when as much as 12,000 pikul (700 tons) of heartwood was extracted annually (1956: 177).

In East Timor, under Portuguese suzerainty, a similar process of appropriation by the State was undertaken. Following measures to limit the cutting and export of sandalwood from the territory, which reached 907 tons in 1910, the Portuguese Government eventually implemented a complete ban on extraction in 1925 (Cinatti, 1950: 15). The Portuguese Colonial Forestry Service then assumed control of reserves, which it managed for a further 50 years.

The success of the Indonesian Independence movement and the withdrawal of the Dutch Colonial power following the Second World War ushered in a new period of resource management and control over sandalwood. As the National Government gradually phased out the formal functions of what was regarded as a feudal Swapraja system and replaced it with a more secular administrative framework, it also assumed greater responsibility for the management of sandalwood stocks. Under the guise of protectionist and conservatory policies, the State assumed ownership of sandalwood in the National interest. This policy was made explicit over time through legislation such as the Peraturan Daerah No 16 1986 (Provincial Ruling)¹² which included the specific provision that:

¹¹ Moor refers to imports such as "coarse blue and white cloth, large pattern chintzes.....china silks and chinaware....muskets and gunpowder." (1837:8)

¹² Based on an earlier regulations, Peraturan Tjendana 1953 and Peraturan Daerah NTT No 11, 1966.

The Provincial Government controls all sandalwood including living or dead, sectioned and split (and) root stock, that is located both within and outside the State forestry zone within the Province of NTT.¹³

As in the earlier Dutch Colonial times the Indonesian State assumed control over the cutting and marketing of sandalwood by Government Authorities under the guise of conservatory resource management. This notionally well intentioned policy, however, did not result in any significant benefits to local Timorese communities and the effective producers of sandalwood. Extraction of timber was based on decisions established by the Government based on five yearly inventories of existing stocks. Farmers and rural populations were allocated a range of defined payments for labouring to cut and gather up the timber at designated collection points. This has been known colloquially as payments for harvesting the trees (*pungut hasil*). Following the 1986 legislation, this amounted to approximately 15 percent of the value of timber harvested. However nominal prices were determined by the Government and tended to be well below any realistic market value. Local farmers also frequently complained about the level of remuneration they received for their labour. As they had no effective ownership rights to the sandalwood seedlings which propagated spontaneously on their lands it was often easier to simply cut out the saplings rather than risk official fines or censure if the trees were damaged or deemed to be neglected (See Perda 16 1986: Pasal 12).

Contemporary issues in the political economy of sandalwood

For a tree with such an illustrious historical pedigree, and one that continues to command high regard for its scented properties, sandalwood has a distinctly ordinary appearance. Easily missed by the unfamiliar eye it grows into a small tree with a dappled grey trunk, straggly branches and clusters of ovate grey-green leaves. Growing to a maximum height of around 10-12m with a diameter of 20-30cm, it is found across the island of Timor up to a height of some 1300m (Ormeling 1956: 92; Monk 1997). The major concentrations of the tree resource, however, are still found along the southern mountains and hinterland of the island. *Santalum album* is reported to do noticeably better in more humid districts that receive favourable orthographic rains associated with the eastern monsoon; the so-called *hujan timur* (eastern rains).¹⁴

There are two types of *Santalum album* found across Timor, a small-leaved variety and a large-leaved variety (Adriyanti 1989 cited in Harisetijono and S. Suriamihardja 1993). Although the larger leafed variety is thought to develop higher oil content, local anecdotal evidence suggests that the smaller leafed variety, referred to simply as *nohmnutu* (small leafed) is favoured because its heartwood and oil content matures faster. Meto Timorese of west Timor refer to sandalwood generically as 'haumeni' (fragrant wood) and they utilise the pulpy red inner bark of the tree as a substitute for areca nut in their betel quids. The real prize, however, is the yellow red central core of the tree and its roots, which develops the distinctive sandalwood fragrant scent as the tree matures. According to some estimates mature trees can produce around 50kg of dry heartwood but this can take 30 years and more of tending and protection before the oil yield develops and up to 50 years for full maturity (cf Ormeling, 1956: 172). Trees begin producing heartwood after twenty years and can attain mature heartwood weights of up to 110kg at 50 years (Warsito and Andayani, 1987). Most of the oil content of the tree is found in the roots (Nuningsih, 1996). Immature sandalwood trees are susceptible to burning and damage from grazing stock and require protection and tending during maturation.

Sandalwood is known as a hemiparasite or semi-root parasite and requires a range of suitable host plants for its nutrition and moisture requirements (Radomiljac et al, 1997). The ecology of natural sandalwood production in Timor (and elsewhere) is therefore complex and is translated into

¹³ "Pemerintah Daerah Tk1 menguasai semua cendana baik yang berupa tumbuhan hidup ataupun mati maupun potongan, belahan, kepingan akar yang belum diolah; baik yang berada di dalam maupun di luar kawasan hutan negara dalam Propinsi NTT"

¹⁴ During the time of the Dutch East Indies Company it was already known that the sandalwood occurred mostly in the southern districts (van Hogendorp, 1779).

significant variation of growth characteristics and heartwood development across the species. Although there has been significant research on the ecology and silvicultural aspects of the tree, a full understanding of ecological dynamics of sandalwood is some way off (Barret, 1989).

Sandalwood is graded into a number of classes which reflect different quality of scented heartwood and to distinguish between dried heartwood and sapwood timber. It is also common practice to bulk up supply by adding the pulp and heartwood of substitute tree wood from other species that have scented timber somewhat reminiscent of sandalwood. *Hau kme* [Kayu merah; *M. azedarach*] and the semi-parasitic, *Exocarpus latifolia*, known locally as *hau papi* are common examples. The 'papi' tree produces an oil which is very similar to sandalwood but rather coarser and sharper in scent. Like sandalwood the bark of the *papi* tree is used by Timorese farmers as a substitute for areca nut in betel quids. *Papi* is a comparatively under-exploited tree that is nevertheless threatened by unmanaged extraction.

Officially there are four main quality classes of sandalwood recognised in Nusa Tenggara Timur (1998). These are set prices and can only be legally sold through a formal auction process controlled by the Provincial and District Governments through its Departments (Dinas) of Forestry (*Kehutanan*).

Class A	Rp 18,000 / kg	(AUD 3.80)
Class B	Rp 15,000/ kg	(AUD 3.00)
Class C	Rp 9,000/ kg	(AUD 1.90)

In addition to these classes of dried and cleaned timber, unprocessed or freshcut timber known as *Kayu gubal* is sometimes sold at a discount which appears to range from just Rp1,000 to as much as Rp13,000 per kg depending on the source of information. The source of this timber is usually stock confiscated from illegal cutting operations. In recent years there has been considerable controversy and a lack of transparency surrounding the official management and trade in sandalwood timber. The emergence or rather, further elaboration, of a black market in the wood has put downward pressure on prices, although this is somewhat offset by the scarcity of the resource and higher prices often offered through illegal trade. Uncertainty in the sandalwood business has led to something akin to a crisis of confidence throughout the industry as the Government struggles to maintain effective management and control.

As an example case study of the present problems facing the sandalwood industry, the experience of sandalwood management in the district of 'South Central Timor' (*Timor Tengah Selatan*) [TTS] is a salutary one. TTS has always been highly regarded for the high quality and former abundance of its sandalwood stocks. Historically it has been one of the most productive sources for sandalwood on Timor.

In 1992, in reaction to the apparent unsustainable and illegal cutting of mature sandalwood trees, the senior District Administrator (*Bupati*) instituted a temporary ban on the logging of sandalwood within his jurisdiction. This exercise was conducted under the auspices of a traditional system of prohibition or taboo known as a '*banu*'. At a ceremony in a forested area near the district Capital, So'e, the '*banu*' was raised and the collective group of senior clan elders of the wider territory agreed to abide by the strictures of the prohibition. The prohibition was known as the '*banu*' to 'guard and protect sandalwood' (*'panat ma ampaloli haumeni*') and was an open ended agreement subject to review in the year 2000.

For a number of years this restriction is reported to have operated effectively. The populations of TTS by and large remain respectful towards the use of sanctioned protection measures based on ancestral traditions, primarily because the (mainly spiritual) sanctions are believed to be effective.¹⁵ However, in 1996 a number of Government initiatives worked to undermine the ban on harvesting.

¹⁵ *Banu* prohibitions are still widely used in Timorese communities to effect controlled harvesting of tree crops, particularly areca nut and coconuts.

In that year the Provincial Department of Forestry (*Kehutanan*) completed an inventory of sandalwood stocks and calculated that the sustainable yield of sandalwood from TTS was around 350 tonnes per annum (Dinas Kehutanan, Kupang, NTT).

Furthermore the Provincial Department, in cooperation with its district counterpart (*Dinas Kehutanan*) agreed to implement a project, known as the 'Operation friendship' (*Operasi bersahabat*), designed to collect all the dried sandalwood from aged logs (*pemutihan*) that were thought to be secreted in villages and hamlets across the district. It is not clear on what basis this intelligence was obtained. Certainly it was (and still is) widely rumoured that Timorese villagers were hiding large stocks of dried and drying sandalwood as a means to thwart illegal harvesters and to avoid accusations of illegal harvesting themselves. The heartwood of sandalwood is very resistant to white ant and borer attack and can be stored for long periods of time without loss of quality (Cinatti, 1950: 12).

In any event, everyone it seems applied themselves to this collection exercise with enthusiasm and according to Forestry sources, initiated widespread felling of remaining existing aged trees to bolster the dried stocks which were offered up. As a result Forestry officials report that during 1996 some 1,743 tons¹⁶ of sandalwood timber was procured in this fashion from TTS alone. Even discounting stocks which had been stored for some time, the harvest was well over the estimated sustainable cut for the region, and substantially more than earlier Dutch Colonial assessments of sustainable yields (Ormeling, 1956: 176). It represented more than double the total production of the district for the previous 5 years (Dinas Perkebunan NTT, 1997). The plunder of sandalwood resulting from this misguided policy prompted the Governor of the Province to issue a decree (Instruksi Gubernur No12, 1997) completely banning the cutting of sandalwood in NTT Province for five years from 1997¹⁷ at which time a further inventory would be taken and the bans reconsidered.

It is these recent bans which have led to the dramatic decline and cessation of Timorese sandalwood exports reported from the Province. Since then much stricter regulatory controls have been placed on commercial sandalwood manufacturers and local, predominantly Chinese, sandalwood artifact producers have struggled to maintain profitability. Limited to the use of existing stockpiles, the remaining sandalwood factories have tended to reduce production of sandalwood items and continue operations only on receipt of confirmed orders. The main products generated in the Kupang based sandalwood factories include carved objects (fans, pens, plaques, rosary beads) and aromatic oils. These tend to be sold in small quantities locally. There is also a continuing demand for milled sandalwood powder (*serbuk*), sandalwood incense sticks (*dupa lidi*) and cones (*dupa kerujut*) especially from Hindu Bali. In addition there is a small business in the manufacture of combustible sandalwood coils as insect repellents.

Despite this concerted effort to place a moratorium on the extraction and export of sandalwood from the region, there is, in fact, little evidence to show that the measures have had a positive impact in terms of conserving remaining growing stock. On the contrary, sandalwood continues to be logged illegally and there is widespread cynicism and suspicion directed at the Government and security authorities about current management and policing practices. With export prices buoyant at around USD 8.00 per kilogram (\$8,000 per tonne 1998) for processed heartwood, there remains a strong incentive to bypass official controls on harvesting. Indeed, the formal banning of sandalwood extraction seems to have done little more than encourage increased illegal cutting and trade in the commodity throughout the territory.

¹⁶ The total yield from this operation from the four main districts was reportedly 2,485.5 tonnes (Pos Kupang, 8 Juli 1998).

¹⁷ In one of those well meaning but futile gestures to arrest the crisis in sandalwood stocks, the then Governor called for all families in the Province to plant 10 sandalwood trees annually. (Jakarta Post, 16 December 1996).

A recent survey of the local Provincial newspaper (*Pos Kupang*), reveals that between 1997-1999 there have been multiple reported incidents of illegal sandalwood cutting and smuggling from the region. In the period between January and March 1998 alone, Police reported 41 cases of arrests or apprehensions for illegally procured sandalwood (*Pos Kupang*: 11 March 1998). Many of these cases involved modest quantities of sandalwood, much of which originates from small-scale extraction by local villagers to supplement farm incomes. However, there are also evidently more influential interests with financial or official backing who have been implicated in the illegal trade. In one feisty commentary in the local *Pos Kupang* it stated that;

...As usual the one or two kilograms carried by people is always confiscated by the security forces and they are held without due process. Yet the sandalwood of businesses which amounts to many tonnes, is allowed to pass because of collusion and nepotism. ...The people and the Government of NTT are very much the losers in this matter because it is an issue that has happens time and again and continues (*Pos Kupang* 11 June 1998).¹⁸

This view appears to be shared widely among the citizenry throughout Timor. As one man from the district town of So'e described it to me, "They tried to ban the cutting, but it only got worse. People steal even the small trees for money and now there is no more sandalwood. It is no longer a money tree (*hau loit*), it has become a tree of dispute/acrimony (*haumlasi*)". He believed there was widespread collusion between certain businesses in Kupang and the '*pejabat*' (officials) of all kinds who administer the sandalwood trade and management. As an example he referred to a recent case where a BRI (*Bank Rakyat Indonesia* – Indonesian Peoples Bank) vehicle loaded with sandalwood was given a police escort out of the district. While the exercise may have been entirely legitimate (although unlikely), there was at the very least a perception of wrongdoing that did little to bolster confidence in the monitoring system. There have been many similar cases. A recent example involved the confiscation of firearms and illegal purchased sandalwood (500kg) in central west Timor implicated a staff member of the District Prosecutors Office (*Kejari*) (*Pos Kupang* 19 October 1999).

Another celebrated case that underscores these complaints was pursued by the Provincial Prosecutors Office (*Kejaksaan Negeri*) of Kupang during 1998. It involved accusations of a fraudulent auction of some 30 tonnes of sandalwood and the alleged collusion of highly placed Government Officials in the district capital of Soe (TTS) and Kupang with a favoured trader CV 'SW'. The case extended into 1999 and the complexity of the case highlighted the confusion surrounding the proper or legal process whereby sandalwood is officially traded and the lack of accountability in terms of reporting the quality and quantity of the trades. As the prosecutor observed, "Why is it that the legal procedures for sandalwood are not clear up to now"? Answering his own query, he noted, "because it always involves officials acting privately and so it is difficult to apply legal sanctions [against official collusion]" (23 May 1998). The case undoubtedly prompted the *Pos Kupang* article (11 June 1998) which speaks of "all the sandalwood which has been recently logged, uncovered or confiscated, always being auctioned by officials to specific companies without following the procedures".

Other problems of accountability lie behind a number of cases involving very significant shipments of sandalwood from the Province. Certain Kupang based traders are permitted to undertake 'inter-island' (*antarpulau*) shipments of sandalwood to Surabaya in Java, based on pre-existing delivery orders. These arrangements, however, have frequently come under suspicion due to irregularities in procedural records and the opportunities for collusion over shipment quantities. Two 1998 cases involving over 150 tonnes of sandalwood shipped to Surabaya created sustained criticism and enquiry over alleged irregularities about sourcing and tax payments (*Pos Kupang*: July – Sept 1998). In March 1999, the Newspaper headline declared that the Province was facing a loss of Rp 1.34 billion (AUD260,000) due to illegal arrangements of these shipments (*Pos Kupang* 5 March 1999).

¹⁸ Biasanya kayu milik rakyat yang hanya satu atau dua kilogram selalu dirampas oleh aparat keamanan dan orangnya di tahan tanpa proses yang jelas. Namun ada juga kayu milik pengusaha keturunan yang jumlahnya bertonton justru dibiarkan karena ada kolusi dan nepotisme. Hal ini tentu sangat merugikan rakyat dan Pemda NTT karena hal ini telah terjadi berkali kali dan berlanjut.

In addition to the suspicion directed against the involvement of civil officials in illegal or corrupt dealings with sandalwood, the role of the police and the army has also been questioned. Occasionally this is done directly, as in the report on 12 March 1998 that 6 cases of sandalwood theft involving 11 tonnes of sandalwood had been directed to the office of the Prosecutor (*Kajaksaan Negeri*). But, none of the cases had been brought to court because the police had refused to hand over the evidence that they had held since December 1997. Early in 1999 four soldiers from Oinlasi (South Central Timor) were jailed for being found with 570kg of illegally acquired sandalwood in an Army truck (Pos Kupang 2 March 1999). Another report cites the case of 8 Police arrested for allegedly illegally confiscating and selling 123kg of sandalwood products valued at Rp84.3million (AUD 16,800) (Pos Kupang 6 February 1999).

More typically, however, the identity of illegal sandalwood loggers are mentioned obliquely with offenders being referred to simply as 'Anonymous groups' ('*oknum* - an acronym originally derived from the phrase *kelompok anonumus* meaning unidentified group, but now more typically used in the sense of the accused). In fact given the openness with which some of these groups operate, the possibility of Army or Police complicity is, at the very least, widely assumed. A recent article in the Pos Kupang for example states frankly that 'Accused Police steal sandalwood' ('*Oknum Polisi curi cendana*'). It goes on to detail the circumstances whereby a police office was found to be actively involved in stealing 87.5kg of sandalwood in the village of Boentuka. Allegations were also made that implicated the District Police Chief (*Kapolres*) who vigorously denied any knowledge (Pos Kupang 22 November 1999). Similarly Monk (1997: 653) mentions a case where Authorities foiled attempts to smuggle 500kg of sandalwood reportedly worth some USD 12,000 from west into east Timor. Smuggling had apparently been rife during the previous two years (Jakarta Post 16 January 1995). Although not mentioned explicitly here, it is likely that these operations of '*oknum oknum*' indicated Indonesian Army complicity if not direct involvement given their tight control over transport and trade in the former Province at the time.

The endemic problem of illegal sandalwood extraction and smuggling is also reported by Simpson (ACIL, 1999) who estimated that in the east Timorese district of Bobonaro alone, some 36 tons of sandalwood was illegally harvested and trucked away during the 1998 dry season. This was calculated to be worth around USD 163,800 annually and probably represented an unsustainable exploitation of the resource. The figure of 36 tons compares with the reported 40-50 tons of sandalwood legally harvested for the whole of East Timor (ACIL 1999: 40). Such activity was clearly sanctioned and probably organised by the Armed forces who were widely considered to control the bulk of trade in sandalwood from east Timor during the Indonesian period of rule.¹⁹

Responses and Reactions: the policy question.

The litany of recent reports and newspaper articles detailing the continuing plunder of sandalwood stocks in Timor over recent years reflects the growing and widespread criticism leveled against Government sandalwood policy and practice within the Province of Nusa Tenggara Timur. One of the central concerns being expressed by a wide range of researchers, advocacy groups and even Government staff not to mention farmers themselves, is the continuing effective monopoly ownership of the resource by the Provincial Government (e.g Messakh and Dewa, 1999; Messakh 1999). During 1998, even the Catholic Archbishop of Kupang was move to ask of the Provincial Government leadership:

Why the sandalwood that grows on the land or fields of the people does not become the property of the farmer or their family, but is claimed as the property of the regional government?...Why isn't sandalwood seen in reality as people's property and the Regional Government simply take a [portion as] tax (Pos Kupang 26 July 1998).

In my own attempts to gain a clearer understanding of the current policy situation in regard to sandalwood, I met with widespread agreement across the spectrum of stakeholders, including senior Regional Forestry staff that sandalwood policy needed to be liberalised and its ownership de-

¹⁹ Official figures for sandalwood production after 1996 are not available.

regulated allowing for individual ownership.²⁰ The Government itself has made some attempts to move in this direction such as the recent 1996 regulation on sandalwood which gives formal effect to a change in the ownership status of the tree. The legislation, which has been ratified, states that:

Sandalwood which grows naturally on individually owned land or land owned by legal bodies, is the property of the individual or body concerned' (Perda 82: 1996 Pasal 4).²¹

On the face of it this change in ownership represents a major concession by Government. However, the reality is that control over sandalwood remains heavily circumscribed by attendant regulatory requirements concerning the management and sale of the commodity. Specifically, all sales of sandalwood must be conducted through official marketing channels at prices set by the Government. Moreover the division of revenue from sales provides for 60 percent to the local Government and just 40 percent to the owner/producer.

This recent attempt to meet popular demand for concessions in sandalwood ownership and benefit to growers has clearly had little appeal. As late as 1999, the Government had set the buying price of sandalwood at just Rp3,000/kg. This represents merely 7.5 percent of export market price (approx. Rp40,000/kg). Farmers or communities that fail to accept the offering price can have their trees subject to confiscation provisions (*Surat Tugas Bupati Kepala Daerah Tk2 TTS*). In such a policy environment it is little wonder that black market sales proliferate.

The sticking point here it seems, and one that has been left substantially unresolved for over a decade at least, is the reluctance of the Provincial Parliament (DPRD; *Dewan Perwakilan Rakyat Daerah*) to reach a consensus over the lifting of Government controls on sandalwood. The major reason for this inaction is likely to stem from the failure of factions within the Parliament to relinquish what has been historically, a lucrative source of regional revenue in an otherwise impoverished Province of Indonesia. Others have reached the same conclusion (Messakh, 1999: 8-9). The recent decline in Provincial revenues from sandalwood sale and export has been compounded by the monetary crisis (*krismon*) which has had a serious impact on Nusa Tenggara Timur.

A further explanation or justification for inaction is the administrative changes underway as part of the Regional Autonomy (*Otonomi Daerah*) process (*Undang Undang No.22 Pemerintahan Daerah*). This formal system of political devolution throughout Indonesia provides increasing opportunities for the management of resources to be undertaken at the District or Kabupaten level of the Province. A recent Provincial regulation (*Peraturan Pemerintah No 62/1998*) formally transferred the management responsibilities for sandalwood to the respective districts. However, the practical implementation and implications of this policy change, it is argued, need to be clarified. Furthermore, there is also the question of the existing Gubenorial instruction (1997) totally banning further logging or extraction of sandalwood trees, which is said to render any change in sandalwood ownership policy irrelevant for the time being. In this context of shifting and uncertain policy directions the question of sandalwood de-regulation looks to be still some way off.

In East Timor, following the extraordinary political turmoil of late 1999 and the withdrawal of the Indonesian administration, the new United Nations transitional administration (UNTAET) has banned any further exports of sandalwood and sandalwood products from the emergent nation until new inventories of stock are undertaken. Discussions with former Forestry staff in East Timor indicate that by March 1999, when they undertook the last forest inventory of sandalwood, there was very little mature commercial standing stock left in the main production areas of Oe Cussi, Bobonaro, Suai and Liquica (M. Nunes, UNTAET pers com. March 2000).

²⁰ It is reported that the former President Suharto also made a suggestion during a visit to the Province that the division of ownership rights for sandalwood be split 80:20 with the majority rights retained by the growers/ land owners. (see also Pos Kupang 26 July 1998).

²¹ Kayu Cendana yang tumbuh secara alamiah diatas tanah milik perorangan atau Badan Hukum adalah milik perorangan atau Badan Hukum tersebut.

Future prospects and possibilities in sandalwood production.

The plunder and ecological decline of sandalwood resources across the island of Timor has its roots in the destructive combination of long-term historical neglect and short term economic opportunism. Attempts by successive governments to halt the unregulated trade in sandalwood timber have manifestly failed, as have their efforts to restrict cutting regimes through management supervision and the monopoly control of marketing. In the present climate where economic conditions in Indonesia have deteriorated and Timorese farming communities move ever closer to the margins of subsistence, the prospects for protecting and developing sandalwood resources appear bleak. The recent wholesale felling of aged sandalwood trees, across the once resource rich southern highlands of Timor, means that it will take at least another generation for resource recovery to anything like recent levels.

In the context of this overall pessimistic assessment, there remain a number of positive aspects or outlooks that may yet form the basis for improvements in the situation. Firstly, there is a continuing world demand for sandalwood timber and oils and market prices remain attractive at around USD8000/tonne, especially from a Timorese or Indonesian perspective. Secondly, the particular species of *Santalum album* growing on Timor retains its world reputation as a premium quality scented wood and oil. The natural conditions on Timor are proven to be conducive to the endemic propagation of sandalwood over wide areas of the island and despite the ravages of recent and past plunder of sandalwood stocks, extensive sandalwood root stock and seed stock remains intact. The spontaneous regeneration of the tree therefore is still widespread and potentially sustainable. Anecdotal reports from farmers and local Government extension workers suggest that there are substantial numbers of immature saplings established across the region and continuing re-growth under present farming conditions. A more quantitative appraisal of existing potential in sandalwood stocks in west Timor at least can be gauged from the results of the 1996/97 inventory of existing sandalwood stocks. This inventory covered the major producing districts of Kupang, South Central and North Central Timor and Belu.

Existing growing stock by height			
Less than 1.5m	1.5-3m	greater than 3m	mature
205,940	85,857	113,666	51,417

Source: Dinas Kehutanan data, Pos Kupang 30-8-98]²²

Leaving aside the reported mature stocks that are likely to be significantly reduced in number at the present time, the inventory indicates that there is substantial regrowth and reproduction of the species across the island. In other words the regenerative potential for the species and the industry as a whole remains highly prospective under an appropriate regulatory and conservatory regime.

In these circumstances, one possibility that has had many proponents over the years, is the development of commercially based sandalwood farming enterprises. The idea being here to move away from the harvesting of naturally occurring sandalwood and towards formalised and towards a range of more intensively cultivated plantation agriculture or modified agro-forestry commercial ventures which seek to mimic the natural growth conditions for sandalwood.

Attempts at sandalwood silviculture in Timor originated in the early twentieth century following a period of evidently unsustainable harvesting of sandalwood (Ormeling, 1956). In west Timor the Dutch Colonial Government attempted to re-establish sandalwood stands during the period 1910-1915 (Rahm, 1925). In the subsequent, so-called *Cultuur Contract* system the Dutch Colonial

²² The island of Sumba is another natural production area although now of minor significance due to unregulated extraction of sandalwood stocks (see Dept Kehutanan 1991). For a comparative perspective on the decline of sandalwood stocks see Appendix 1.

Forestry Service developed an arrangement whereby farmers would undertake to tend sandalwood plantings for several years in return for access to arable food cropping land. Interestingly, this system prefigured later Indonesia Government attempts to develop participatory reforestation programs including the so-called 'tumpang sari' system, the *Hutan rakyat reboisasi* and more recent attempts with semi-commercial multi-purpose forestry, (*Hutan Kemasyarakatan*). As Ormeling noted in the 1950's however, the results of the Colonial forestry efforts were meagre and never really extended beyond experimentation. He comments for example, that the majority of the 208 hectares of sandalwood plantings in the years 1923-51 had either partially or completely failed (Ormeling, 1956: 176).²³

There is small irony in the fact that by 1999, Indonesian government efforts to propagate sandalwood and develop commercial stands, have also not extended much beyond basic experimentation and field trials of cultivation treatments. (e.g. Surata, 1992; Surata, Harisetijono and Sinaga, 1995). A limited area planting trial in south central Timor with a support nursery is about the extent of contemporary attempts by the Forestry Research Institute (*Balai Penelitian Kehutanan*) to promote commercial sandalwood production. Present researchers comment that efforts to propagate sandalwood artificially have proved difficult to sustain and expand into commercial scale enterprises (Suriamihardja and Susila, 1994). Problems include high rates of seedling failure, selection problems with host plants for the semi-parasitic sandalwood establishment and difficulties emulating the ecological requirements for sandalwood host plant sequences. The extended length of time it takes to develop scented heartwood in the tree makes it less attractive as a commercial commodity and vulnerable to illegal cuttings and damage from fire. Cherrier's comment, based on studies of sandalwood development in New Caledonia highlights the management challenges. He noted that heartwood content of the tree is inversely proportional to its vigour (1993). In other words attempts to develop or encourage fast growing sandalwood trees may be counter productive in terms of generating heartwood content. Sandalwood requires a degree of environmental stress to produce at its best.

Despite these and other challenges to plantation sandalwood, there has been considerable research undertaken to identify and develop successful silviculture and management technologies of sandalwood (e.g. Radomiljac et al, 1998; Surata, 1992; Surata et al, 1994; Fox, 1990). Recent work in Western Australia on *Santalum album* has also demonstrated the viability and prospects for plantation establishment (Radomiljac, 1998; Shea et al, 1998). This work has potentially direct relevance to developing appropriate strategies on Timor. Researchers suggest the possibility of incorporating one or more high value timber species within a sandalwood silviculture system to act as long-term hosts for sandalwood. They conclude that a "biodiverse farm forestry system, producing two or more high value timber products appears possible" (Shea et al, 1998: 13).

On the basis of these and other positive research developments, the possibilities for sustaining and promoting sandalwood silviculture across Timor would appear to be reasonably good. Bio-physical requirements are understood, nursery protocols are in place (Barret and Fox, 1995), trained forestry staff are available and reforestation is an official priority in Timor. What constrains further development and the creation of a sustainable sandalwood farm forestry industry is to a significant degree the failure of government policy and regulatory controls. Specifically, this includes the continuing adherence to a State Forestry control over sandalwood stock that discourages conservation, commercialization and farm forestry production. There is also the continuing failure of law enforcement to control illegal harvesting, under-reporting and smuggling of the timber. These factors have combined to defeat the efforts of researchers and forestry managers in Timor to date. However, they also point to an alternative direction in sandalwood policy and programming that may offer better prospects. This requires a shift in focus to the thousands of small-holder farmers of Timor who have for centuries incorporated sandalwood production within their diversified and complex inter-cropping system of agriculture.²⁴

²³ Attempts to establish plantations in East Timor under the Portuguese Colonial Government were also undertaken with only limited success (Cinatti, 1950).

²⁴ There is a strong belief in Timor that the scent of sandalwood is largely a feature of the respect and traditional protection offered by ritual communities. There are recent reports that sandalwood stocks have

In supporting this policy shift, it is important to recognise the distinction between a sandalwood industry based around commercial industrial plantations or wood-lots and one focused on the promotion of small-holder farm production. The former suggests and implies a higher investment commercial operation utilizing wage labour systems, technical intervention, and long-term protected block cultivation. A farmer based system on the other hand, needs only to facilitate and expand an existing system of agro-forestry where sandalwood has traditionally provided a long-term domestic investment within an economically diversified agricultural asset base.

Apart from an equity argument that supports greater economic benefits to near subsistence farmer communities, the shift to a small-holder farm based commercial sandalwood focus, arguably has distinct advantages from an agro-ecological perspective. This argument has a number of strands.

Firstly, one of the important agronomic factors associated with sandalwood propagation is that new growth can occur either from seed or vegetative regrowth. Much of the research into sandalwood has focused on seed reproduction and improvements in seed quality and nursery propagation. Timorese farmers do not purposefully plant sandalwood. However, there is strong evidence to suggest that vegetative regrowth from lateral rooting of maturing sandalwood is at least as important in regenerating the stock. Nuningsih et al (1994) for example, report that on the basis of their surveys in south central Timor, vegetative regeneration is by far the most common form of propagation in the natural environment. One sandalwood 'mother tree' can produce multiple new shoots and regrowth from its extensive lateral root systems. Nuningsih (1996: 20) for example, reports up to 35 new sandalwood saplings regenerating from the lateral roots of one tree, while Hamzah (1976) has recorded up to 40 regrowth saplings in a radius of 8m from one 37 year old mature tree in south central Timor. One of the bio-physical benefits of lateral root vegetative regrowth, is that the young saplings continue to derive nutrients from the main root system during the crucial establishment phase. Thus, unlike seed propagation and transplantation, which have high rates of establishment failure, vegetative regrowth provides effective natural conditions for shoot survival.

More significantly still, Nuningsih demonstrates that under appropriate conditions, which include rocky coralline slopes over 30 percent²⁵ and shallow lateral rooting (0-13cm depth), vegetative sandalwood regrowth is significantly enhanced by the application of fire (1996: 14). Fire induces scorching and fissuring and in the bark of lateral roots promoting shoot regrowth.

This combination of factors suggests that there are strong associations between naturally occurring sandalwood stands and the historical practices of Timorese slash and burn shifting agriculture. In other words there appears to be a strong anthropogenic influence in long-term development of sandalwood across Timor. The promotion of vegetative regrowth as a product of clearing and burning combined with long-term protection of the young saplings form part of the traditional practices of indigenous Timorese mountain agriculture.²⁶ The reality that up to 83 percent of extant sandalwood is found in the fallowed bush gardens of Timorese farmers, and only 17 percent in designated Forest reserves lends supports this contention (I Komang Surata, Forest Research Institute, pers com, Dept Kehutanan 1991: 4). As does the fact that sandalwood does not grow in forest with closed canopies but needs sunlight in order to thrive. These features suggest that there are distinct advantages in promoting and adapting sandalwood production through existing agro-silvicultural techniques and then encouraging long-term protection and tending by local farmer producers. This is a view now acknowledged by some senior staff of the Forestry Research Institute

not been producing the same degree of scented heartwood and that this is related to the widespread plunder and vandalism against the tree. I note here that this could just be a reflection of the increased cutting of immature sandalwood trees that have not had time to develop heartwood.

²⁵ Timor's geomorphology is composed of extensive areas of uplifted limestone deposits and ancient coralline reef formations.

²⁶ An interesting additional result of Nuningsih's research is that once adventitious root regrowth has reached a height of 1m or more on the lateral root system, the saplings are viable even if the oil bearing roots of the 'mother tree' are then extracted.

in Kupang who are pessimistic about the prospects for establishing successful sandalwood plantations. It also finds support from earlier notable observers. Rahm, for example, who did some of the first intensive research on sandalwood in Timor commented that, "[sandalwoods] spreading is closely associated with the shifting cultivation of the natives because it finds the best conditions for its growth on these fields. Where sandal is found at present there is nearly always former cultivation" (1925: 533). Ormeling has made similar though less favourable observations. He notes that

Everyone travelling through Timor is immediately struck by the fact that *Santalum* grows mostly on cultivated or abandoned ladangs [bush gardens]. Sandalwood seeds find a suitable environment in the loose soil where a crop has just been harvested. Root growth here also is favourably influenced by the artificial wounding of the roots, which often occurs on the ladang while planting or weeding. The young sandal plants are protected by the pagar [fence] (1956: 173).

He goes on, however, to observe that the new sandalwood is then neglected and abandoned to grazing animals and fire, but this may be more a reflection of the existing policies on sandalwood and the decline in traditional proscriptions than historical practice. The fact is that a symbiotic relationship appears to have existed for generations between Timorese farmers and sandalwood. This relationship, with few exceptions, is one that has received little research attention but any serious attempt to re-vitalise sandalwood production in the hinterland of Timor (and Sumba) needs to formally acknowledge and support the role of near-subsistence farming communities in its cultivation.

Concluding Remarks: Indigenous rights and natural resource management

The crisis in the sandalwood industry across Timor and the unremitting plunder of mature stocks has reached a point where the very viability of the species on the island is threatened. Given the failure of successive governments over the course the twentieth century to either manage extant growing stocks sustainably or to create viable commercial plantations, alternative approaches are desperately needed.

Under the National Indonesian system of classification for forest resources, sandalwood falls into the category of a 'minor forest product'. This designation reflects the institutional bias towards timber (major forest product) within the Indonesian forestry sector, while simultaneously belying the historical significance of sandalwood to the economy of Timor and nearby islands. Sandalwood is also classified as a non-timber product (Monk 1997) and, like other forest resources in this category, such as gums, resins, bamboo, fruits and nuts, the rights of rural communities who traditionally exploit and manage these resources have tended to be denied or ignored by State interests. (Poffenberger, 1990). Seen in this context the depletion of sandalwood stocks on Timor and Sumba through unsustainable extraction in the face of numerous attempts by successive Governments to manage the resource can be understood as a microcosm of the wider processes of forest resource mismanagement across Indonesia and Southeast Asia generally. The literature on deforestation and the progressive appropriation of indigenous forest community rights and benefits by State interests is extensive (see for example Hurst, 1990, Poffenberger, 1990). It underscores the political weakness of marginalised forest communities and the unfortunate track record of centralised paternalistic Government complicity and neglect in the alleged interests of national development (World Rainforest Movement, 1990). What makes the case of sandalwood unusual, if not unique, is the extension of State control over a 'forest resource' which is cultivated and managed predominantly by local farmers and communities on their own land.

If solutions are to be found in this downward spiral of sandalwood resource depletion they lie in a combination of two key initiatives. Firstly, the effective transfer of resource and management ownership from State monopoly to grower and landowner control. This entails not only the recognition of private and community based ownership rights, but also extensive market de-regulation both in terms of pricing regimes and transparent marketing channels. At the same time

more attention needs to be directed to the policing of sandalwood theft and tougher sanctions against illegal trading activities.

A second complementary approach requires a re-orientation of the role of forest resource managers from a control and policing role with an industrial plantation focus, to one of facilitating long-term agro-forestry in partnership with local farming communities. This is consistent with observations elsewhere in the Forestry sector. As Dove has commented, 'all available evidence suggests that the centralizing tendency in Indonesian statecraft leads too easily to local economic hardship and resource degradation. His recommendation, in relation to the rubber industry but the principle is the same, is that instead of developing expensive and problematic nucleus estate projects, the government would be better advised to assist existing traditional small-holder *in situ* at far less cost (1996: 54). Similarly, on-farm, in situ research and support to improve sandalwood production and cultivation is likely to have long-term benefits to upland farming communities who are among the poorest in the region. Under a more supportive governmental regime, there are also opportunities for strengthening and re-vitalizing traditional indigenous conservatory practices that have been eroded over generations of neglect and disregard.

Calls for just this form of transfer and re-direction are well supported both in terms of encouraging the regeneration and conservation of the species, and as a long overdue recognition and redress of the equity rights of the many peasant communities on whose land it grows. Any modest State levies and taxes on the subsequent sale of the commodity should be used to facilitate and improve the industry. Kushalapa (1998) commenting in relation to just this issue in relation to Karnataka State (India), considers as baseless the fears that a relaxation of sandalwood regulations would lead to complete destruction of the species. If this were so, he argues, it would have already happened to the teak and rosewood species that are equally valuable but not controlled like sandalwood.

In the end, it can only be the collective action of the Timorese community, in partnership with the Provincial and District Governments in NTT, that determines whether sandalwood in Timor has any chance of becoming once again a significant export commodity and even a symbol of the islands future. A similar challenge faces the emergent National Government in East Timor (Timor Lorosa'e). There, the creation of new Government structures offers the opportunity to redress the policy failures of the past and institute more favourable conditions for the sustainable farming of sandalwood. The historical track record of resource mismanagement in the region combined with the endemic rural poverty of the island makes this a challenging but worthwhile prospect. With effort the sweet smell of sandalwood might once again become an integral part of Timorese farming systems and be known as the 'white wood money' tree (*hau pan muti*) and not the 'tree of acrimony' (*haum lasi*) which is easier to eradicate than to tend.

**Appendix 1: Comparative results from sandalwood inventories 1987/88
and 1997/98 in Nusa Tenggara Timur**

	<i>Mature trees</i>		<i>Young trees</i>	
	<i>1988</i>	<i>1998</i>	<i>1988</i>	<i>1998</i>
Kabupaten				
Kupang	11,438	309	17,609	1,921
South central Timor	91,528	3,170	193,365	13,789
North Central Timor	46,461	2,165	85,235	9,437
Belu	35,615	1,278	-	14,851
East Sumba	3,014	930	83,046	11,830
West Sumba	312	6,186	16,326	20,362
TOTAL	188,388	14,038	395,881	71,190

Source: Dinas Kehutanan NTT 1998

I note that these figures are not entirely consistent with those presented in the text (above) and here one must recognise the inherent unreliability of statistical data from Government sources in NTT. The data from West Sumba for example looks suspect. Moreover, inventories in NTT are not necessarily based on field inspection but on the verbal reports of local communities. In the current climate there is little advantage for villagers to provide accurate information. Indeed there remain widespread suspicions that local hill people have cut and stored significant amounts of sandalwood in the face of continuing theft by outsiders. Nevertheless something of the scale of decline over the last ten years can be gauged from these figures. Growing stocks on the basis of this data have declined in the order of an 85 percent over the last decade.

Sandalwood production in East Timor 1990-1996

	<i>1990</i>	<i>1991</i>	<i>1992</i>	<i>1993</i>	<i>1994</i>	<i>1995</i>	<i>1996</i>
Heartwood (m3)	197.3	73.8	174.9	118.2	103.9	76.26	146.3
Sandalwood Oil (ton)	2.7	2.6	1.75	4.0	2.1	2.0	3
Powder (Serbuk/ton)	0.33	-	-	-	-	-	-

Source: Timor Timur Dalam Angka 1996

The main recent period of unsustainable extraction of sandalwood in East Timor occurred between 1997 and 1999 and reliable official figures are not available.

Acknowledgements

This paper was written under the auspices of the Resource Management in the Asia Pacific Project, Australian National University. Funding from the project made it possible to undertake fieldwork in Timor during 1999 and 2000.

References

- ACIL Pty. Ltd., 1999. Bobonaro Area Development Project [BARDEP]: An assessment of agricultural development potentials in East Timor. Unpublished Project Report. Melbourne, Australia.
- Applegate, G.B. and McKinnell, F.H., 1993. The Management and Conservation Status of Santalum Species Occurring in Australia. In F.H. McKinnell (ed) *Sandalwood in the Pacific Region*. Proceedings of a symposium held on 2 June 1991 at the XVII Pacific Science Congress, Honolulu, Hawaii. Canberra Aciar Proceedings No.49. pp5-12.
- Bappeda Tk1 dengan Kantor Statistik, Propinsi Timor Timur, 1996. Timor Timur Dalam Angka
- Barbosa, Duarte, 1921. *The Book of Duarte Barbosa (1518)*. London 1918-21 M. L Dames.
- Barret, D.R., 1989. Santalum Album (Indian Sandalwood) Literature Review. *Mulga Research Centre Report* No 3. Perth. Curtin University of Technology.
- Bligh, William, 1789. *A Voyage to the South Seas*. Facsimile Editions.
- Boxer, C.R., 1947. The Topasses of Timor Mededelingen No 73. *Koninklijk Vereniging Insich Instituut*. Amsterdam.
- Boxer, C.R., 1948. *Fidalgoes in the Far East. 1550-1770*. The Hague
- Cherrier, J-F, 1993. Sandalwood in New Caledonia. In F.H. McKinnell (ed) *Sandalwood in the Pacific Region*. Proceedings of a symposium held on 2 June 1991 at the XVII Pacific Science Congress, Honolulu, Hawaii. Canberra: ACIAR Proceedings No.49. pp19-22.
- Cinatti vas Monteiro Gomes, Ruy, 1950. *Esboco historico do sandalo no Timor Portugues*. Lisboa: Oficinas Graficas Casa Portuguesa.
- D _____, 1851. Reis naar het rijk van Amanoebang op Timor in October 1850. (Journey to the realm of Amanuban in Timor). *Tijdschrift voor Nederlandsch-Indië* 13(2): 153-179.
- Department Kehutanan, 1991. Cendana (Santalum Album L.) Kupang. Bagian Proyek Perencanaan Pimbinan dan Pengendalian Pembangunan Kehutanan Kantor Wilayah, Department Kehutanan.
- Dinas Kehutanan, 1998. Unpublished Statistical data on forest inventories. Kupang, NTT.
- Dove, Michael R., 1996. So Far from Power, So Near to the Forest: A structural analysis of gain and blame in Tropical Forest Development. In C Padoch and Nancy L Peluso (eds) *Borneo in Transition: People, Forests, Conservation and Development*. Oxford:Oxford University Press. 41-58.
- Forman, S., 1977. East Timor: Exchange and political hierarchy at the time of the European discoveries. In Hutterer K.L (ed) *Economic Exchange and Social Interaction in Southeast Asia: Perspectives from Prehistory, history and ethnography*. Ann Arbor: Centre for South and Southeast Asian Studies, University of Michigan.
- Fox, J.E.D., 1990. Silviculture of Santalam album in Timor NTT. (Report for the period 1988-1990). ACIAR /Australia-Indonesia Sandalwood Project. Curtin University Western Australia.
- Fox, James J., 1977. The Harvest of the Palm. Ecological Change in Eastern Indonesia. Cambridge, Mass: Harvard University Press.
- Fox, James J., 1992. The Great Lord Rests at the Centre: The Paradox of Powerlessness in European-Timorese Relations. *Canberra Anthropology*. 5(2) 22-33.
- Fox, James J., 1996. The Paradox of Powerlessness: Timor in Historical Perspective. Paper presented to the Nobel Peace Prize Symposium. The University of Oslo.
- Freidberg, C., 1978. The development of traditional agricultural practices in Western Timor. In J Friedman and M.J. Rowlands (eds) *The Evolution of Social Systems*. Proceedings of a meeting of the Research Seminar in Archaeology and Related Subjects held at the Institute of Archaeology, London University. London: Duckworth and Co. pp137-172.
- Gjerum L., Fox, J.E.D. and Ehrhart L., (eds), 1995. Sandalwood Seed Nursery and Plantation Technology FAO, Suva. RAS/92/2361. Field Document No.8.
- Groeneveldt W.P, 1880. Notes on the Malay Archipelago and Malacca compiled from Chinese Sources. *Verhandelingen Koninklijk Bataviaasch Genootschap van Kunsten en Wetenschappen*. Vol XXXIX 1 (1-144).
- Guillemard F.H.H, 1894. *Stanford's Compendium of Geography and Travel* (new issue) Australasia Volume 2 Malaysia and the Pacific Archipelagos. London: Edward Stanford.

- Hamilton, L. and Conrad, C.E. (ed), 1990. Proceedings of the Symposium on Sandalwood in the Pacific: April 9-11,1990. Tech. Rep. PSW-122, Pacific Southwest Research Station, Forest Service, US. Department of Agriculture, Honolulu.
- Hamzah, 1976. Sifat Silvika dan Silvikultur Cendana (*Santalum album L.*) di Pulau Timor. *Laporan Lembaga Penelitian Hutan*. Bogor 227.
- Harisetijono and Sutarjo Suriamihardja, 1993. Sandalwood in Nusa Tenggara Timur. In McKinnell, F.H. (ed) *Sandalwood in the Pacific Region*. Proceedings of a symposium held on 2 June 1991 at the XVII Pacific Science Congress, Honolulu, Hawaii. Canberra ACIAR Proceedings No.49 pp39-43.
- Hurst, P, 1990. Rainforest Politics: Ecological destruction in South-east Asia. London, New Jersey: Zed Books Ltd.
- Husain A.M.M., 1983. Report on the Rehabilitation of Sandalwood and the trade in Nusa Tenggara Timur, Indonesia. World Bank PPIP Project Report, West Timor.
- Kushalapa K.A, 1998. Trade Liberalisation in Sandalwood. In Radomiljac, A.M, Ananthapadmanabho, H.S, Welbourne, R.M, and Satyanarayan Rao, K. (eds), *Sandal and its Products*. Proceedings of an international seminar held on 18-19 December 1997 organised by the Institute of Wood Science and Technology (ICFRE) and Karnataka State Forest Department, Bangalore India. Canberra: ACIAR Proceedings No 84 24-26.
- Leitao H., 1948. *Os Portugueses em Solor e Timor de 1515 a 1702* (The Portuguese in Solor and Timor from 1515 to 1702) Lisboa: Tip. Da Liga dos Combatentes da Grande Guerra.
- Ormeling F.J, 1956. The Timor Problem: A geographical interpretation of an underdeveloped island. Groningen: J P Wolters.
- McWilliam A.R, 1996. Severed Heads that Germinate the State: History, Politics and Headhunting in Southwest Timor. In Hoskins, Janet (ed) *Headhunting and the Social Imagination in Southeast Asia*. Stanford:Stanford University Press. 127-166.
- Messakh, Matheos V., 1999. Orang Timor Mencuri Cendana di Tanah Sendiri. Suatu tinjauan terhadap kebijakan Pemerintah Daerah NTT tentang komoditas cendana dan implikasi bagi kesejahteraan masyarakat lokal. [Timorese Steal Sandalwood from their Own Land: A study of NTT Government policy towards sandalwood and the implications for local community welfare] Lokakarya Penulisan Pegelolaan Sumber Daya Alam untuk Rakyat. Lembaga Alam Tropika Indonesia (LATIN) [unpublished].
- Messakh, M and Apolos Dewa, 1999. Dalam Hutanku ada cendana, tapi bukan milikku. [In my forest there is sandalwood but it does not belong to me]. *Udik: Advokasi Newsletter* (5) Kupang. August .
- Monk, Kathryn A., De Fretes, Yance and Reksodiharjo-Lilley, Gayatri, 1997. *The Ecology of Nusa Tenggara and Maluku*. Australia, Indonesia, U.K, USA: Periplus Publications.
- Moor, J H., 1837. Short account of Timor, Roti, Savu, Solor. In Notices of the Indian Archipelago and adjacent countries (part 1). Singapore: [Reprinted London:Frank Cass, 1968].
- Nuningsih, R., Mudita, I .W., and Mella, W., 1994. Kajian Permudaan Cendana (*Santalum album L*) Secara vegetatif pada Habitat Alamiah di Timor Tengah Selatan NTT. [Study of vegetative root propagation of Sandalwood in natural habitats of South Central Timor]. Kupang. Universitas Nusa Cendana.
- Nuningsih R., 1996. Kajian Perkembangan Sistem Perakaran Anakan Vegetatif Alami Cendana (*Santalum Album L.*) pada Habitat Alaminya di Kabupaten Timor Tengah Selatan. [Study of development of vegetative root sprouting of Sandalwood in natural habitats of South Central Timor]. Kupang: Universitas Nusa Cendana.
- Pigafetta, A., 1969. *Magellan's Voyage: A Narrative Account of the First Circumnavigation*. [trans. and edited R. A. Skelton]. New Haven: Yale University Press.
- Poffenberger, Mark (ed), 1990. *Keepers of the Forest: Land Management Alternatives in Southeast Asia*. Manila: Ateneo de Manila University Press.
- Pos Kupang [Kupang Post]. Harian Umum. Various Issues 1996- 1999.
- Radomiljac, A.C., 1998. The influence of pot host species, seedling age and supplementary nursery nutrition on *Santalum album* Linn (Indian sandalwood) plantation establishment within the Ord River Irrigation Area, Western Australia. *Forest Ecology and Management* 102:193-201.

- Radomiljac, A.M., Ananthapadmanabho, H.S, Welbourne, R.M, and Satyanarayan Rao, K.(eds), 1999. *Sandal and its Products*. Proceedings of an international seminar held on 18-19 December 1997 organised by the Institute of Wood Science and Technology (ICFRE) and Karnataka State Forest Department, Bangalore India. Canberra: ACIAR Proceedings No 84.
- Rahm Th, 1925. Sandelhout op Timor. *Tectona Buitenzorg* Vol 18 499-545.
- Ramanathan, C., 1997. Indian Sandalwood Trade. In TED Case Studies: Sandalwood Case. www.american.edu/projects/mandala/TED/sandalwood.htm
- Risseeuw, P., 1950. Sandelhout (Sandalwood). In C.J.J. van Hall and C.van deKoppel, *De Landbouw in de Indische Archipel* (Agriculture in the Indonesian Archipelago). The Hague Vol 3 pp686-705.
- Shea S.R, Radomiljac, A.M., Brand J., and Jones, P., 1998. An Overview of Sandalwood and the Development of Sandal in Farm Forestry in Western Australia. In Radomiljac, A.M et al (eds), *Sandal and its Products*. Proceedings of an international seminar held on 18-19 December 1997 organised by the Institute of Wood Science and Technology (ICFRE) and Karnataka State Forest Department.
- Shoba, Rai, 1990. 'Status and Cultivation of Sandalwood in India' Symposium of Sandalwood in the Pacific April 9-11 Hawaii. 1990 pp65-71.
- Steenis C.G.G.J van, 1939. The native country of sandalwood and teak: a plant geographical study. *Hendelingen 8e Nederland Indische. Natuurwetenschappelijke Congres*, Sorabaja, pp408-418.
- Surata, K., 1992. Effect of host plants on growth of sandalwood (*Santalum album*) seedlings. *Santalum* 9:1-10.
- Surata, K., Harisetijono and Sinaga, M., 1993. Effect of intercropping system on sandalwood growth (*Santalum album*) *Santalum* 20:17-24.
- Suriamihardja S and I Wayan Widhana Susila, 1993. Strategi dan Upaya Pelestarian Potensi Cendana di Nusa Tenggara Timur [Strategies and Efforts for the Preservation of Sandalwood in NTT] *Savanna*. Kupang: Balai Penelitian Kehutanan. 1-8.
- Suripto, 1992. Pemulihan Potensi Cendana di NTT. Makalah pada Seminar Department Hari Bhakti. Department Kehutanan NTT. Kupang.
- Therik, Gerzon Tom, 1993. Wehali The Four Corner Land: The Cosmology and Traditions of a Timorese Ritual Centre. PhD Thesis. Canberra: The Australian National University.
- Warsito S.P. and Andayani, W., 1987. Pengusahaan hutan tanaman Cendana. Makalah disampaikan pada diskusi Cendana. Universitas Gadjadara. Yogyakarta.
- Widiyatmika M., 1986. Laporan Penelitian: Masalah Sosial Budaya dalam Pengelolaann Kayu Cendana di Propinsi Nusa Tenggara Timur. Proyek Studi Sektoral /Regional Dengan Kontrak Nomor 112/ Department Pendidikan da Kebudayaan, Universitas Nusa Cendana, Indonesia.
- World Rainforest Movement, 1990. *Rainforest Destruction: Causes, Effects and False Solutions*. Malaysia: Jutaprint.