SUSTAINABLE MANAGEMENT OF FORESTS FOR MULTIPLE BENEFITS -

Is there anything new under the sun?

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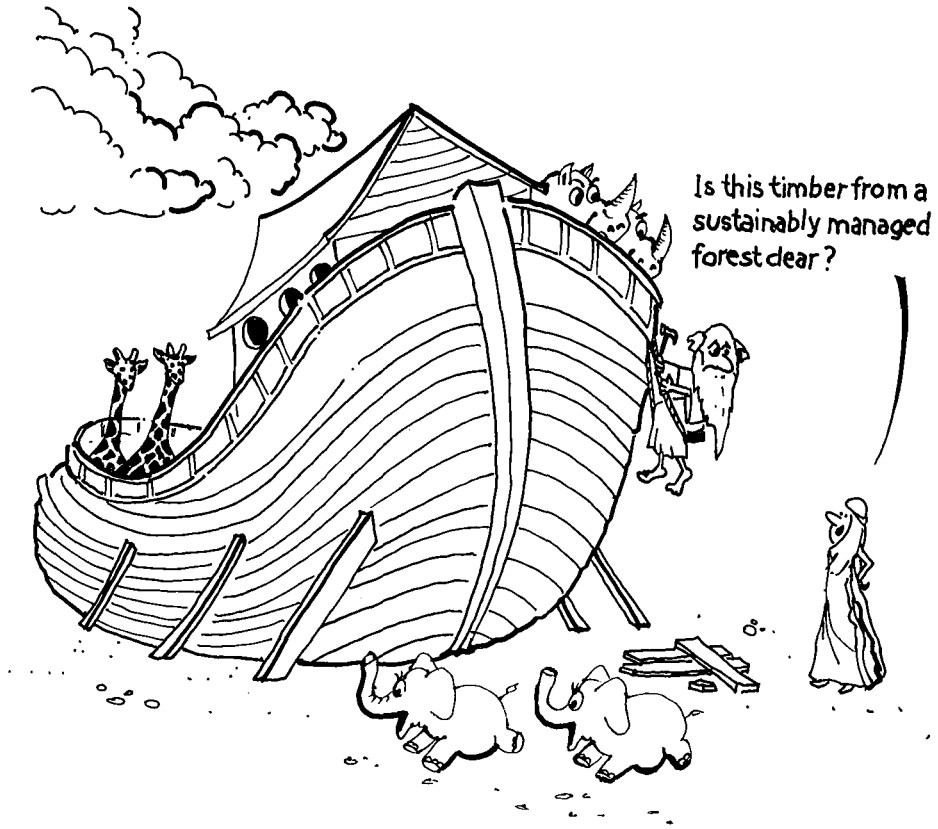

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SUSTAINABLE MANAGEMENT OF FORESTS FOR MULTIPLE USE BENEFITS

Is there anything new under the sun?

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The thing that hath been, it is that which shall be;
and that which is done is that which shall be done:
and there is no new thing under the sun.
Is there any thing whereof it may be said, See, this is new?
it hath been already of old time, which was before us.

Ecclesiastes 1:9,10

INTRODUCTION

I have chosen as my text Ecclesiastes 1:9,10 and pose the question *"Is there anything new under the sun?"*. Even the most cursory review of papers submitted to successive Commonwealth Forestry Conferences reveals that the concepts of sustainability and multiple benefits are not new to forestry (Ward, 1952; Sisam, 1962; Place, 1974; Kirkland, 1989).

They feature frequently in current forestry literature and in the popular media, and so often in the latter articles lament the parlous state of the world's forests that it would be easy to be pessimistic. It could be concluded that, despite our undoubted capacity to talk and write about sustainability and multiple benefits, in many areas of the world we have failed miserably in applying these concepts. As a young postgraduate student in Canada I was advised by a good friend, an old Latvian forester (he had been awarded the gold medal for forestry by the Czar) that "the advantage of being a pessimist is that you are never disappointed", Nonetheless, I remain optimistic about the future of forests and in particular the opportunities to demonstrate our care for forests and our ability to share their bounty amongst this and future generations.

The problems which confront us in managing the world's forests are complex; even microsites within each forest have unique suites of characteristics and may require "tailor-made" management. Having suffered, as I am sure many forest managers have, of a plethora of visiting "experts" to their forests proclaiming panaceas, I am not about to offer more "expert" prescriptions. Rather I will focus on drawing on some broad principles and illustrate their applications from my own experience in Western Australia. This does not imply that forest management in Western Australia is perfect.

We have made mistakes and we can expect to make more yet. But principles are pointless if they are not based on real world experiences.

The south-west of Western Australia is the most isolated region in the world, but forest policy makers and forest managers there face, to a greater or lesser degree, the same problems - conflict over forest use and management practices. Most of us have experienced overlap of Central, State and Local Government Authority functions, excessive clearing of forests, financial constraints, land use conflicts, and of course the challenge of achieving sustainability and multiple use.

The solution of problems in this multifaceted reality is complex enough for any of us. Yet in Western Australia our management is complicated even further by our problems with *Phytophthora cinnamomi*, to a degree that few who have not experienced it might imagine. This problem, whilst of much greater direct significance for nature conservation than it is for sustained forest production, nonetheless impinges, usually adversely, on management for almost every one of the multiple benefits from our forests. Despite the great importance to us of dieback due to *Phytophthora cinnamomi*, it is by and large a problem unique to us. I will concentrate therefore very largely on those concerns which we all share in managing forests.

This paper is deliberately provocative because while "the jury may be out" on the question - *"Is there anything new under the sun?"* I determined, at least in this address, to look differently at these fundamental forest management concepts. But first to set the scene by describing the managed forests from which my arguments and experience are drawn.

SUSTAINABLE MANAGEMENT FOR MULTIPLE BENEFITS IN WESTERN AUSTRALIAN FORESTS

Western Australia's forests occur in the south-west of the State and experience a Mediterranean type climate. The natural forests occupy an area of 2.4 million hectares and broadly comprise the dry sclerophyll jarrah *(Eucalyptus marginata)* forest (1,600,000 hectares), the karri *(Eucalyptus diversicolor)* forest (175,000 hectares) and a smaller area of woodlands dominated by wandoo *(Eucalyptus wandoo)* and tuart *(Eucalyptus gomphocephala)*. There are approximately 100,000 hectares of monterey *(Pinus radiata)* and maritime *(Pinus pinaster)* pine plantations and 20,000 hectares of exotic hardwood (mainly) Tasmanian Bluegum *(Eucalyptus globulus)* plantations. The natural hardwood forests occur almost entirely on public land and over 80 per cent of the plantations are State owned.

The natural forests are managed for a multiplicity of benefits. They are an essential component of the catchments which provide over half the water supply for more than one million people in the south-west of Western Australia; annually they yield 1.5 million cubic metres of wood, which is processed into a variety of products from high grade charcoal to fine furniture; they provide 2 million days of recreation use each year and are a key component of the burgeoning tourism industries "product"; the natural forests are the State's largest contiguous reserve system and they provide habitat for a number of the State's unique and diverse flora and fauna.

The softwood plantations currently yield over 300,000 cubic metres of wood and are expected to contribute one million cubic metres annually early in the next century.

Harvest of high quality wood fibre from the hardwood plantations has just commenced.

The publicly owned forests are managed by the State's Department of Conservation and Land Management (CALM), an integrated agency responsible for the management of marine reserves and land areas exceeding 19 million hectares in State forests, national parks, conservation and other reserves. CALM is also responsible for protection of flora and fauna throughout the State on both private and public land.

The area of natural forests is essentially static, although clearing for agriculture of lower quality forest is still occurring on some privately-owned land. Since 1985 all new forest plantations have been established on privately owned farmland in partnership with owners. The State is committed to rapid expansion of its plantation estate in both private and public sectors. It is anticipated that over 100,000 hectares of hardwood plantations will be established on cleared farmland over the next 10-15 years. If this target is achieved, more than 2.5 million cubic metres of high quality wood fibre will be available annually by the end of the first decade of the 21st century. There is sufficient suitable land for a further 100,000 hectares of softwood plantations, though enough finance is currently available for the establishment of only an additional 2,000 hectares per annum over the next decade.

The existing plantation estate already plays a significant role in protecting underground water supplies. The new estate being established on farmlands will make a major contribution to reversing soil and water degradation and providing a multiplicity of benefits (in addition to wood fibre production) which will provide a financial return to farmers and the community which will at least equal the value of the wood fibre which is produced.

WHY SHOULD WE MANAGE FORESTS SUSTAINABLY AND FOR MULTIPLE BENEFITS?

The quest for sustainable management of forests which benefit many users would be well served by recognising that in some situations there are cogent practical and ethical reasons why these objectives are inappropriate. There are some places in the world where the rapid conversion of forests for other land uses is highly appropriate. Who can justify the maintenance of a forest ecosystem in a country short of land for food production when that forest produces relatively little income and its conversion to food crops is essential to ensure the survival of the local population? The case for land uses other than forests was argued by Choong (1974) at the 10th Commonwealth Forestry Conference and still stands.

In some situations where forests are retained or created, management for a single use can be justified on purely efficiency grounds. The opportunities for single use forest management, even in forest plantations, are diminishing rapidly. It follows that if most loss of forests can be attributed to land clearing for agriculture, the forces that cause this loss will also resist the establishment of tree crops on agricultural land unless tree crops can be managed so that they have benefits to agriculture and other competitors for land. In Western Australia for example, there is negligible pressure for the clearing of natural forest in public ownership, but there is massive resistance to broadscale planting of trees on farms from fenceline to fenceline.

The idea that we should not destroy the forest as we use it, or use it in a way that pre-empts some uses in the future, has impeccable logic; though what we mean by

sustainability needs clarification. The principle of sharing the bounty of the forest by maximising the number of benefits we can derive from it, has not only an ethical and egalitarian justification, it also makes economic and political sense. Invariably the maximisation of the number of benefits which can be derived from forests will ensure that the total value of the forest and the number of constituencies that support retention of the forest will be increased.

In this "age of the environment" a system which has characteristics such as -

- being powered by solar energy and having the potential to capture 70 per cent of incoming solar energy;
- having near perfect recycling capacities;
- exhibiting dynamic resilience to disturbances;
- being able to absorb carbon dioxide and whose principal physical product is recyclable carbon (Table 1);
- possessed of temporal, spatial and structural characteristics which provide the maximum opportunity for simultaneous delivery of a variety of benefits

are attributes which should provide forest managers with a comparative advantage in the quest for "sustainable development".

Table 1

Energy required to produce one tonne of each product and tonnes of CO_2 emitted during production

	Energy (KWH equivalent)	CO_2 produced (tonnes)
Aluminium	15 000	25.0
Iron	3 000	2.5
Cement	2 000	0.3
Bricks	700	0.1
Timber	300	-0.2

It is not surprising that the concepts of sustainability and multiple benefits are hallowed in the literature on forestry. Why then do forest managers have so much difficulty applying them in practice? How is it that so many do not know, or will not believe, that forests can, and are, being managed sustainably for multiple benefits? Is there some fundamental deficiency in forest managers which prevents them from dealing with the realities of biological, economic and political facts of life?

WHAT ARE SOME OF THE REALITIES?

If we are to make progress we must accept realities such as -

- Men, women and societies have the capacity to be altruistic (increasingly as we become more civilised) but when confronted with a choice between altruism or self-interest, particularly when the former is at the price of survival or even

higher standards of living, the choice is invariably self-interest. Often, but not always, self-interest is measured in dollars.

- Forest policy, and consequently the forest management that can be practised, will be determined by politicians. Put succinctly - "it's the numbers that count" (Shea, 1992).

- Forest policy and forest management have become major political issues at the local, national and international level. For example, there have been 76 Government Inquiries into forests in Australia since 1946.

- Marshal McLuhan was right - "the medium is the message" and the vast majority of the community, at least in the developed countries, find out about their forests through the media.

- Forests have a peculiar disadvantage as a consequence of the above realities because they require long planning horizons and the returns from forests, because invariably they occur some time in the future, suffer a financial penalty because of society's time preference for money today over money tomorrow.

- The most dangerous management system is one which has policy-makers or managers who are not accountable for their actions. The institutional structures which surround forest policy-makers and managers, and the long-term nature of forest enterprises, makes forestry peculiarly vulnerable to this fundamental flaw.

- Public perceptions, forest management technology, markets and forest utilisation patterns are changing at an ever increasing rate. But the culture of forest managers (possibly because of selection pressure) and certainly because of the nature of their training which is often one-off, (Binkley, 1991), usually has been based on steady-state assumptions about society, and more often has been devoid of any reference to an essential tool of the modern manager - marketing.

- If there is enough time to be absolutely certain before we make a decision and practice management, it is prudent to wait. But invariably to delay in making a decision will result in a decision by somebody or nature which has consequences more damaging. Forests and the forces that control forest policy are dynamic and doing nothing until we are certain may be the worse option.

ARE THERE BIOLOGICAL CONSTRAINTS WHICH PREVENT US ACHIEVING SUSTAINABILITY AND MULTIPLE BENEFITS FROM FORESTS?

What is sustainability?

We will never achieve sustainability if we don't know what it is, but the literature can be confusing (Gale and Corday, 1991).

Sustainable forestry can mean that any management can be practised provided that we do not break one butterfly's wing lest we trigger some undefined sequence of events which at some time in the future results in a change in some process in the forest ecosystem and/or some loss or diminution in the wellbeing of some yet unidentified species of plant, vertebrate or invertebrate. Advocates of this view of sustainability find it difficult to embrace plantation establishment if it involves exotic species, even if they are being established on land previously cleared for agriculture because two to three rotations into the future something might go wrong.

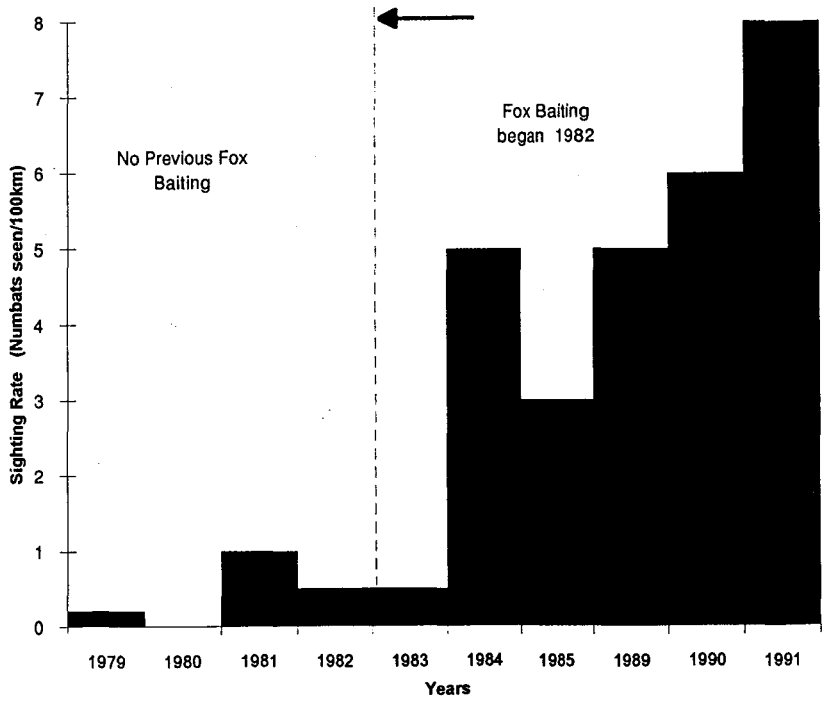
But how does the application of the "precautionary principle" in its purest form help us "save" the moist tropical rainforests? The overwhelming evidence is that the loss of moist tropical rainforests is occurring, not because of forestry activities, but because it is being converted to agricultural land (Rowe et al, 1990; Plumptre and Karani, 1993). This change in land use is being driven by the perception, often the reality, that the tropical rainforest lands are more valuable to man when cleared. One of the few strategies available to stem the tide of clearing is to adopt sustainable management of these forests so that they do acquire a tangible value (Poore et al, 1989). Sustainable management, particularly when it involves harvesting of tropical timbers, will increase the value of the forest but it does involve a risk. Is it ... "prudent to be cautious in supporting projects that lead to the manipulation of forests until we know or at least can approximate, the level of tolerance of the ecosystem" (Botkin and Talbot, 1990) ... while each year areas the size of Great Britain are cleared of rainforest for agriculture because we won't risk attempting to harvest the forest sustainably to give it some value?

Does the precautionary principle mean that we should not manage to avoid natural catastrophic events or control known destructive agents?

For example, in the jarrah and karri forest of Western Australia total withdrawal of the use of prescribed fire to reduce leaf litter and twig accumulation would result in the occurrence of conflagrations which will result in widespread death of trees and wildlife and massive release into the atmosphere of carbon dioxide and nitrogen (Underwood and Christensen, 1981; Christensen and Abbott, 1989).

In the jarrah forests of Western Australia it is absolutely certain that the introduced European fox is a major factor contributing to the drastic reduction of populations of some mammals (Christensen, 1980; Kinnear et al, 1989; Friend, 1990). We know with certainty that it is possible to dramatically reverse the decline in native mammals by regular aerial applications of poisonous baits (Figure 1).

FIGURE 1



Research was carried out prior to the broadscale application of this technique to confirm that the baits (the poison in the baits is an analogue of a natural occurring poison in some native plants which occur in the forest) did not adversely affect native fauna. Our planned burning regimes are based on intensive research into the effect of fires on the forest ecosystem (Christensen and Kimber, 1975). Of course we don't know with ***absolute certainty*** that there may not be ***some*** long-term effect on ***some*** part of the ecosystem. Notwithstanding that we can never be absolutely certain that the application of prescribed fire or baits to remove feral animals from the forest has no adverse effects, we intend to continue both practices because the real benefits far exceed the perceived risks.

Sustainable forestry can mean management of forests so that they sustain maximum wood fibre production. Exponents of this view would contend that the resilience of forests is so great and the management is so appropriate that fundamental processes and the biota are not adversely affected. But maximum fibre production invariably means eventual elimination of some of the important seral stages and the loss of some forest structures which are essential for survival of some species.

Both extremes of the spectrum can be argued, but in the vast majority of situations these positions are irrelevant. There is a consensus that the basic requirement for sustainability is that management or use of a forest should not destroy the ***potential*** of the forest ecosystem to produce the same quality and quantity of goods and services in perpetuity (Franklin, 1992). This means that the fundamental ecosystem processes, that are essential to retain the regenerative forest's capacities and the gene pools, are not lost by management or use of the forest (Ecologically Sustainable Development Working Group, 1991).

While this concept of sustainability implies that it can be assessed on objective scientific criteria, it contains two subjective elements. Firstly, there must be a subjective determination of the level of risk that can be tolerated. Secondly, the appropriate balance of uses in the end can only be a value judgement.

"Sustainability" encompasses a spectrum of concepts in the community because what we mean by sustainability depends on which constituency - (Gale and Corday, 1991) have identified at least eight - we belong to.

Is it technically possible to manage forests and tree plantations sustainably for multiple benefits?

There are some forests, and there are probably sites within all forests, which are so fragile or biologically so important that no risk should be taken and no intervention allowed. There are also many examples where forest sustainability has been destroyed because of incompetent management. But I propose that there is no ***technical*** reason why a large proportion of the world's forests cannot be managed and used for a variety of purposes, including wood production, with minimal risk of destroying the ecosystem processes which are required for their regeneration and maintenance, and with minimal risk to the loss of plant and animal species. I base this proposition on three general observations -

- Contrary to what has been generally assumed, most forest systems have evolved mechanisms to deal with catastrophic natural events and are consequently resilient.

  Examples include repeated recovery of vegetation and wildlife from wildfire initiated by lightning strikes in very dry summers (eg jarrah forest 1961, Victorian mountain ash forest 1939, the boreal forest - Hunter, 1992), hurricane-

force winds (eg New England Region of USA 1938, Queensland rainforests) volcanic eruption (eg Mt St Helens 1980).

- There are numerous examples of forests which have been utilised brutally and yet have regenerated and are functioning forests.

  For example, a small area of karri forest cleared in 1863, ploughed, planted to wheat and later abandoned, resulted in a stand of forest so remarkable that it is now a popular tourist attraction. At Boranup, karri forest was clearfelled in 1883 without any regulation from Government. Because the limestone subsoil was not suitable for agriculture, the land remained under State control. The magnificent regrowth stands are now part of a national park (Christensen, 1992). Similar wildfire generated stands of *Eucalyptus regnans*, more than 50 metres tall, are to be found across southern Tasmania.

  Much of New England USA, and the cotton belt of south-eastern USA, was cleared for agriculture by 1850. Most of the croplands and pasture were subsequently abandoned and have been recolonised by forest, though not always of the same species of trees (Spurr and Barnes, 1980).

  Forests can be altered and destroyed. For example, long-term shifts in climate can result in changes in the species composition (eg Churchill, 1968) and when extreme enough can result in a shift to non-forest, as happened in parts of North America where prairie replaced forest (Spurr and Barnes, 1980). The most detrimental process to forests is the repeated cycle of clearing, burning and grazing by sheep, cattle and goats which prevents regeneration. This process was responsible for the extensive deforestation in much of the Mediterranean basin (Thirgood, 1981) and elsewhere (Westoby, 1989).

  But forest management operations, including harvesting, regeneration and burning, do not differ substantially in their impacts from those of natural disturbing processes ***except in their timeframe***. They are unlikely to cause fundamental long-term change because of the range of adaptations to disturbance inherent in most forest species; most can cope with change which is essentially short-term and reversible (Abbott and Christensen, in prep.).

- There are examples of forests which have been managed and utilised for decades which exhibit no measurable diminution in the functioning of fundamental processes or the loss of species as a consequence of either utilisation or management.

  Despite 130 years of logging (the first 60 years of which were not regulated by Government) and three decades of prescribed burning, largely in spring, in Western Australia's jarrah and karri forests extinctions of vertebrate and plant species due to forest management are not evident. Indeed, many species now rare or locally extinct elsewhere in Western Australia survive only in the forest. Species at the apex of food chains are surviving well. There is no evidence that any of the fundamental ecological process have been adversely affected. There has been no deterioration in the water quality of forested streams.

  It is even technically possible to manage "fragile" moist tropical rainforest In Queensland, selection logging of rainforest over a period of 80 years has not compromised forest productivity or conservation of species and ecological processes (Vanclay, 1990; Poore et al, 1989).

It is important to emphasise (because some constituencies will be outraged by the proposition) that my claim that it is technically possible to manage most natural and plantation forests sustainably for multiple benefits has three important caveats. Firstly,

although it may be ***technically*** possible, this does not guarantee that it will be implemented. Secondly, it is impossible, even with the best technical management, to eliminate all risk. The degree of risk involved and the risk which can be tolerated will vary accordingly to the nature of the forest ecosystem and the community's tolerance of risk. Thirdly, it is technically impossible to maximise the production of all benefits or uses of all areas of all forests all of the time.

Integrated forest management

Risks can be minimised and forest benefits optimised by integrating forest management practices.

Natural forests

Implementation of multiple purpose forest management in natural forests has invariably involved -

- Determining levels of demand for a particular use and attempting to reconcile that demand with the capacity of the forest to supply it at a sustainable level.
- Identifying areas within the forest where this use is allocated a priority.

The principal disadvantages of this "demand-based" approach is that one or more uses might determine (or is at least perceived to determine) forest management strategies. Such forest strategies also fail to maximise the potential to exploit the synergism between different uses. For example, achievement of the individual targets for different forest uses invariably results in zoning or compartmentalisation of the forest according to different uses. While zoning has a legitimate role to play, excessively rigid zoning does not take account of the fact that forest ecosystems are dynamic, that many forest uses are compatible, and that whenever there is a conflict between uses, these can be reconciled or minimised by varying patterns of use in time and space. The effect of over-compartmentalisation in a forest to accommodate different uses is to reduce the capacity of the forest manager to maximise the potential aggregate benefit of all values of the forest.

By excessive compartmentalisation of the forest, demand-driven forest management exacerbates the potential for community conflict over forest use. Each constituency seeks to maximise its favoured use and attempts to advance this by increasing the area of forest designated for that use.

Integrated forest management incorporates the essential elements of most forest management systems. It differs fundamentally from previous systems of management, however, in that it recognises the forest as a single biophysical system rather than an aggregation of useful products (eg water, wood, recreation, etc) and establishes the overriding objective for management as the maintenance of the forest ecosystem and its processes. This approach means that the level of use of the forest is determined by the natural processes of the forest, not by the demands of a particular use or group of uses.

The principal elements of the integrated approach are:

(i) That the forest is a recognised dynamic interconnected system (ie, one which varies in time and space).

(ii) That the principal focus of forest management is on the maintenance of the physical and biological processes that sustain forest ecosystems, including the maintenance of the biodiversity.

(iii) That a prime objective of forest management is the maintenance of a reasonably balanced forest structure. Forest management strategies that aim to produce either a forest composed entirely of mature trees or of immature trees would not satisfy element (ii) because each stage of development (or structural element) of the forest has a particular expression of ecological processes and a particular suite of plant and animal species associated with it.

(iv) That the supply of any value from the forest will not exceed levels that would cause forest processes (including a balanced forest structure) to be destroyed, or exceed levels that cannot be sustained in perpetuity.

(v) That the level of supply of a particular value will be set below that which adversely constrains other forest values and by the priority that the community places on that value relative to others.

A forest strategy that has as its prime objective the maintenance of the forest ecosystem will deliver a mix of forest values. It is possible to develop strategies which -

- maximise the collective benefit of the mix of all values, and to
- alter the mix of values according to community wishes.

without departing from the prime objective.
In some situations, maximising a number of values (within the constraint of the prime objective) can be achieved in the same place at the same time. For example, increasing the production of water in salt-free zones of the jarrah forest is compatible with thinning the forest for increased timber production, because this treatment favours both uses.

In other situations, potential conflicts between values can be minimised by dispersing the uses in time and space. For example, recreation and forest harvesting are in direct conflict if they are practised simultaneously in the same place. Provided the level of demand for other values is not so high as to constrain options (and this would be unlikely to occur because high-use levels would affect forest processes), these uses can be dispersed in time and space so that they are not in conflict.

There are some situations in which the supply of values cannot be reconciled. For example, intensive recreation and timber harvesting are incompatible with wilderness values. But even these conflicts can be avoided provided that the level of demand is not excessive. Also, wilderness qualities can be restored in other parts of the forest to ensure a continuous supply of that value.

The level of supply of an individual value from the forest will be less than its potential supply where forest management and use is integrated. The supply of any value at its maximum level may be at the expense of the forest and other values. Integrated forest management will, however, maximise the collective benefit of all forest values.

Ultimately the community must decide the relative priority it places on different forest values. It is probable that community assessments of the desirable mix of values will change over time. But because the prime objective of an integrated forest management system is the maintenance of the forest (including a balanced forest structure) changes in community priorities can be accommodated.

Integrated forest management incorporates the concepts and philosophies of "new forestry" (Franklin 1989), and accommodates what has been the most vexing challenge to forest managers - the maintenance of "old growth".

For example, the principles of integration have been used to develop a strategy that incorporates a structural objective in the karri forests. In setting the structural objectives for the karri forest, the ecological principle - maintenance of the oldest stage of forest

development requires that each preceding stage is equally represented - was adopted (CALM, 1992). The karri forest is comprised of a mosaic of even-age stands of trees. The size of each stand varies from one hectare to hundreds of hectares depending on the scale and intensity of the event which initiated the stand. If it is assumed that the ecological processes associated with the oldest stage of forest development commenced at between 100-140 years and that death occurred at 150 years, the maintenance of the oldest stage of development would require that for each hectare of forest 150 years old there should be one hectare 149 years old, one hectare 148 years old etc. If this simple model were correct, approximately one-third of the forest could be sustained in the mature stage of development.

But karri trees do not all die when they reach 150 years, although mortality of large trees occurs at this stage of development and progressively increases. There is a major increase in mortality at 250 years and few trees survive beyond 350 years (Raynor, 1992). As the karri forest matures, it becomes progressively more susceptible to fire. Consequently, in determining the forest structure that will sustain the oldest stage of development, allowance must be made for attrition of these stands due to wildfire. It is impossible to quantify accurately the factors which would determine the rate of attrition of karri forest stands once they reach the oldest stage of development. Under natural conditions the rate would have varied over time and between different sites. If it is assumed, however, that ***on average*** karri stands reach an age of 200 years, the structure of the forest necessary to sustain the oldest stages of karri forest development is as shown in Table 2.

Table 2

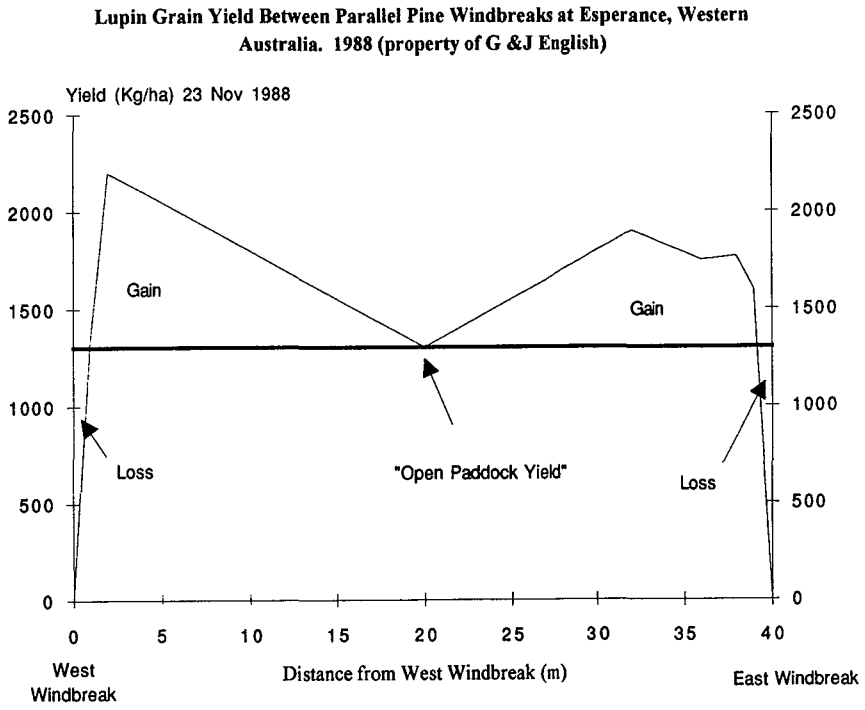
Stages of Development	Percentage Representation
Establishment	4%
Juvenile	8%
Immature	48%
Mature/Senescent	40%

The karri forest management strategy incorporates requirements such as - reservation of old regrowth stands in reserves and riparian corridors, retention of regrowth stands until they reach the mature/senescent stage of development - to ensure these structural goals are achieved (CALM, 1993).

Tree crops

The principles of integration are also an essential prerequisite to the widescale adoption of trees as a crop on agricultural land. Tree crops can significantly improve the product of agricultural crops and animals (Figure 2). Tree crops can also improve soil fertility and reverse soil and water degradation (Ingram, 1990). But to achieve these benefits the location, size and configurations of tree crops on the farm must be flexible. The expansion of tree crops onto farms in Western Australia is dependent on their integration into the total farm plan (Shea and Hewett, 1990); Shea et al, 1993).

FIGURE 2
(Source Bicknel pers. comm)



The Bitterlick Syndrome

The manipulation of forests dates back to medieval times. But despite its antiquity, or in part because of it, forest technology and our knowledge of forest ecosystems has lagged behind other related fields of vegetation and land management. There are legitimate reasons why technological advances have been relatively slow. Forest ecosystems are complex and it takes much longer to validate an innovative system of management when the turnaround time is measured in decades rather than annually. The investment in forest research and development has been nowhere near that of agriculture.

But forest managers have technologies available today - in part because of the foresight of our predecessor's who established the trial plots and the research programs which have now borne fruit - which were not even conceived of 10 years ago. There are problems with transferring the technology to the forests, but these are not intractable. A very real deficiency is that the forest managers' vision of what forest management can achieve has been shackled by a culture which has been shaped by the frustrations imposed by earlier primitive technology.

There is no technological fix. But the new technology, when integrated with economic and political strategies, provides opportunities for achieving levels of sustainability of forest uses which have not been dreamed of.

For example -

- The availability of information technology, for example geographic information systems and computer simulated models, to forest managers has the capacity to significantly reduce the weight of two of the heaviest crosses that forest managers have had to bear - the ability to know where the components of the forest ecosystem are in space and predict what will happen to them over time when they are used.

  A geographic information system which described all of the values on all of the different sites in the south-west forests of Western Australia, in relation to all the legal and political constraints on land use, was one of the essential prerequisites to achieving a rational resolution of the potential conflicts between the Australian Heritage Commission (a Federal Government body) to list and protect national estate values and CALM which was required to manage the forest for sustained production of multiple benefits (CALM and Australian Heritage Commission, 1992).

  Even simple technological advances have the potential to remove savage practical constraints on the application of more sensitive forest management techniques. For example, forest managers can now, by use of satellite geographic position systems, locate rare plant species or the boundaries of special use zones in seconds whereas in the past with compass and chain it would have taken weeks.

- The identification, demarcation and prediction of productivity of sites is a critical element of forest management. The combination of information technology with good science, increasingly permits site characterisation and mapping to be carried out with relative ease and remarkable precision.

  For example, the ability to predict both the volume and wood quality of *E. globulus* plantations on farmland sites, permits sensitive integration of trees and crops into farm systems and significantly reduces the risk to investors (Inions, 1991; 1992; 1992; Shea and Hewett, 1990).

- Forest management, when it adversely affects the appearance of landscape, or scenery, probably causes more adverse community reaction to forest use than any other activity. Visual Resource Management - which is based on the premise that the scenic or visual qualities of the landscape constitute a resource in their own right - provides the opportunity to lighten the load of another cross that foresters bear. This technology involves the identification, description, assessment and management of scenic values in the same way as the resource values such as flora, fauna, water, timber and recreation. It is now possible with the aid of Geographic Information Systems and computer simulations to integrate visual resource management into the integrated forest management package. The age of "virtual reality" has arrived in forest planning and management enabling forest managers to ensure that "what you see is what you get" (Revell, 1991).

- Forest scientists have been undertaking tree improvement programs for more than 50 years, but it is only comparatively recently that the benefits have been

realised. For example, the Western Australian *Pinus pinaster* tree breeding program, initiated 30 years ago, has resulted in productivity gain of 36 per cent and improvements in form and wood quality which make these new trees almost unrecognisable from those which grew from the seed imported from Portugal 50 years ago (Butcher and Hopkins, 1993). Productivity improvements, as a result of tree breeding and improved cultural techniques, of 400 per cent have been achieved for *E. globulus* in Western Australia (Butcher unpubl.) and the average productivity of *Pinus radiata* has been increased by 51 per cent (Whiteman et al, 1993).

While these tree breeding programs have taken decades to deliver, the new field of biotechnology offers the potential for even greater advances in shorter timeframes. Gene transfer and new methods of reproduction such as somatic embryogenesis are now possible and have the potential to revolutionise tree crop production (Cheliak, 1989).

Biotechnology could even be employed to conserve the biodiversity of threatened forests. It is being employed in Western Australia to conserve the genetic resource of our diverse heathland flora, which is threatened by a plant disease caused by the plant pathogen *Phytophthora cinnamomi* (Rands).

ARE THERE ECONOMIC CONSTRAINTS WHICH PREVENT US ACHIEVING SUSTAINABILITY AND MULTIPLE BENEFITS FROM FORESTS?

Why bother with economics?

Leslie (1987) has argued eloquently that economic theory, as it is applied to forest management and use is hopelessly flawed. I am sympathetic to his proposition, but my own experience is that the people or institutions that I have approached to -

- provide finance for the management of Western Australia's natural forests (note that as we move up the spectrum to minimise risk and optimum use forest management becomes more expensive);
- plant commercial tree crops on their land (that is change their land use);
- invest in forests;

are unfortunately not.

Forests or tree plantations must compete in the real world for finance and while there are factors (for example security of the resource) the rate of return on an investment in forests, and when the return will occur, is a major factor determining if the investment decision (whether it be by a large company or government agency to manage a natural forest, or a farmer to plant trees, or villager not to clear forest) will be in favour of forests or tree plantations.

The realities of society's time preference

Every forestry graduate has wrestled with Faustman and most have at some stage of their career bemoaned its unfairness. It is a fact, as Leslie (1987) has concluded, that

the actual discount rate chosen is based on judgements which, to a large degree, are subjective. But investment in forests has the disadvantage that almost invariably a return on that investment will come some time in the future and we must live with the penalty that this carries because dollars earned tomorrow have less value than dollars earned today.

In Figures 3 and 4 below I have attempted to illustrate the magnitude of this penalty to natural forest and plantation forest managers. Figure 3 shows the effect of time and value of product produced on the value of a natural forest with relatively low productivity and management costs. Figure 4 shows the effect of time and productivity on the return from a commercial tree plantation with relatively high management costs. The shapes of the graphs will change as the discount rates (these examples assume 5 per cent) are varied, but there will always be a financial mountain to climb because of the ***relatively*** long-term nature of forestry enterprise. The right investment decisions are more likely if we stop pretending that there isn't a mountain and look at ways in which we can climb it by increasing the value of forests.

FIGURE 3

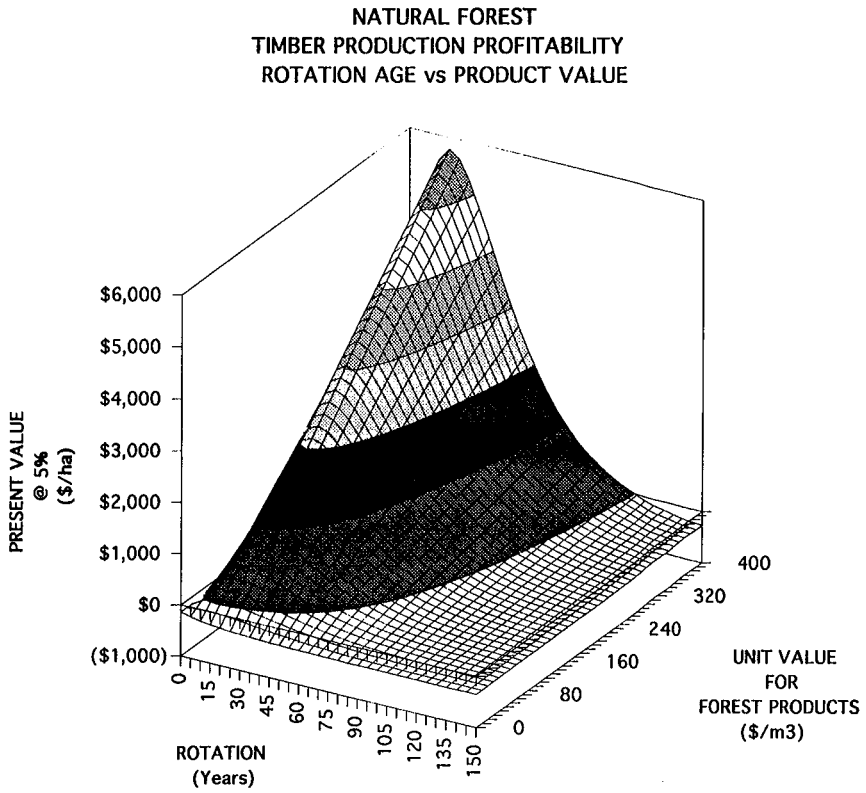
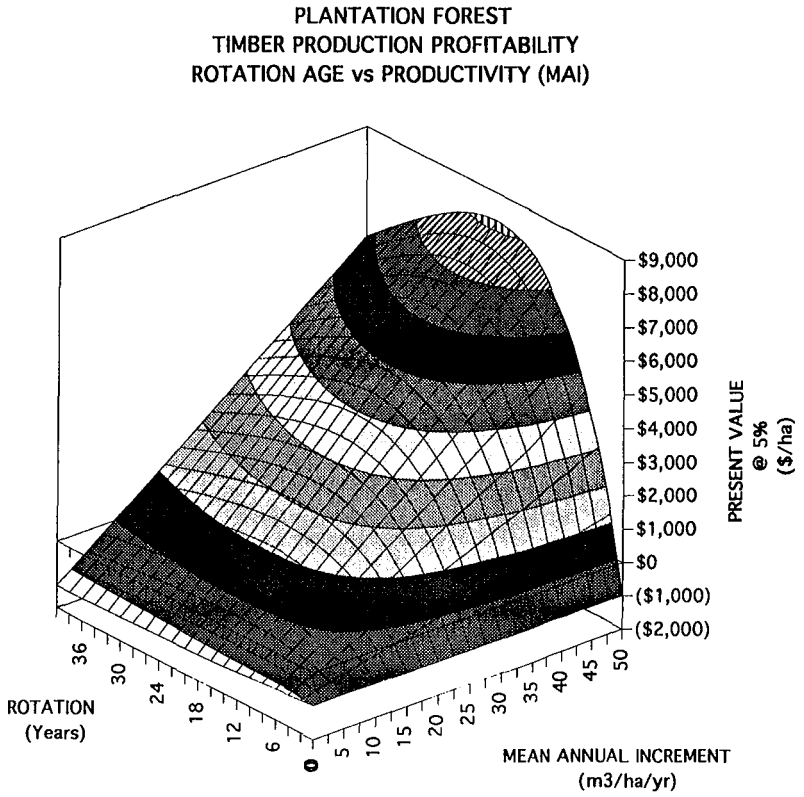


FIGURE 4



Increasing the value of the products

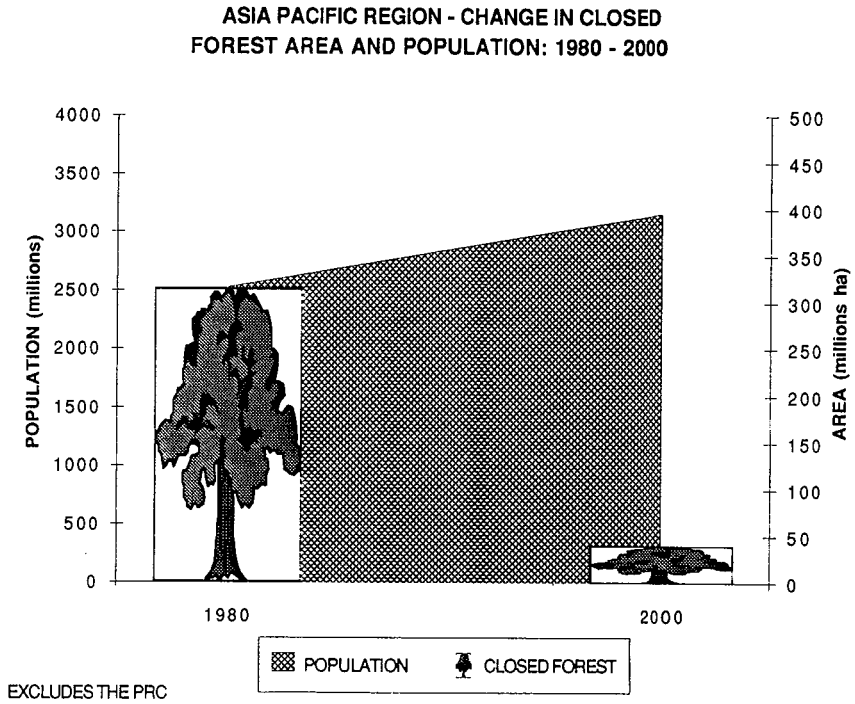
There are many forest uses that are not even priced or the fees collected. For example, in Western Australia it is only recently that some forms of recreational use have attracted a fee. In many, if not most, forests of the world including Western Australia, there is not even a notional accounting for the value of the water protection and production functions of forests.

The use of forests for wood fibre production is often criticised but at least it usually attracts a return - albeit often a poor one. There are a variety of "institutional problems" (for example Haley and Luckert 1993) in many countries which have resulted in wood fibre being under-valued. But the fundamental cause is that the world market has been distorted by the existence of large areas of "God given" forests. Wood is being supplied into the market from three different sources - as a by-product from forests which are being cleared, from natural forests which are managed and from forests which have been established as plantations (Poore et al, 1989). The price of the wood fibre that is being supplied from a large proportion of the world's natural forests does not reflect the cost of replacement of the forest's wood production function and other values which are disturbed in the process of wood fibre extraction.

There have been numerous studies and predictions of the future supply/demand scenario for world wood fibre (Sedjo and Lyon, 1990). Not surprisingly, all authors place caveats on their predictions because there are too many variables.

World forestry stocks, however, are being depleted (Figure 5) and wood fibre consumption is increasing. Inevitably, the distorting effects of "God given" forests will diminish and eventually be eliminated. This does not mean there will be a world wood fibre famine because it is possible to produce the wood fibre required from plantations. But wood fibre prices must increase if man-made forests are to meet the global demand for wood fibre.

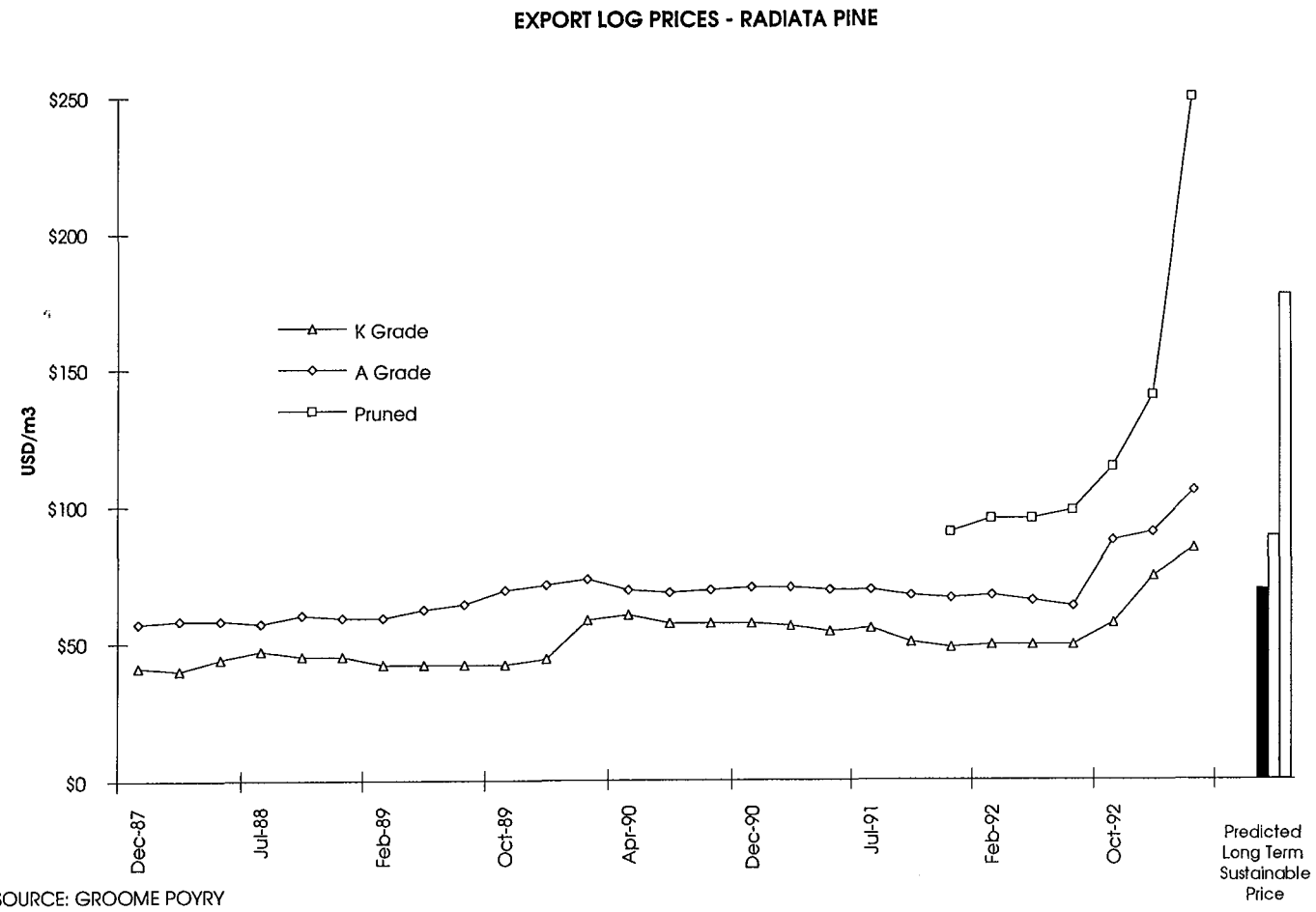
FIGURE 5
(Source Groome Poyry)



Note: Excludes Peoples Republic of China.

In recent times, wood prices have increased substantially on the international market. For example, in New Zealand prices for Radiata pine logs have increased by between 60-100 per cent (Figure 6). It is likely that current prices will decrease, but there is developing consensus that the long term sustainable prices will be significantly higher in real terms than those that have been achieved in the past.

FIGURE 6
(Source Groome Poyry)

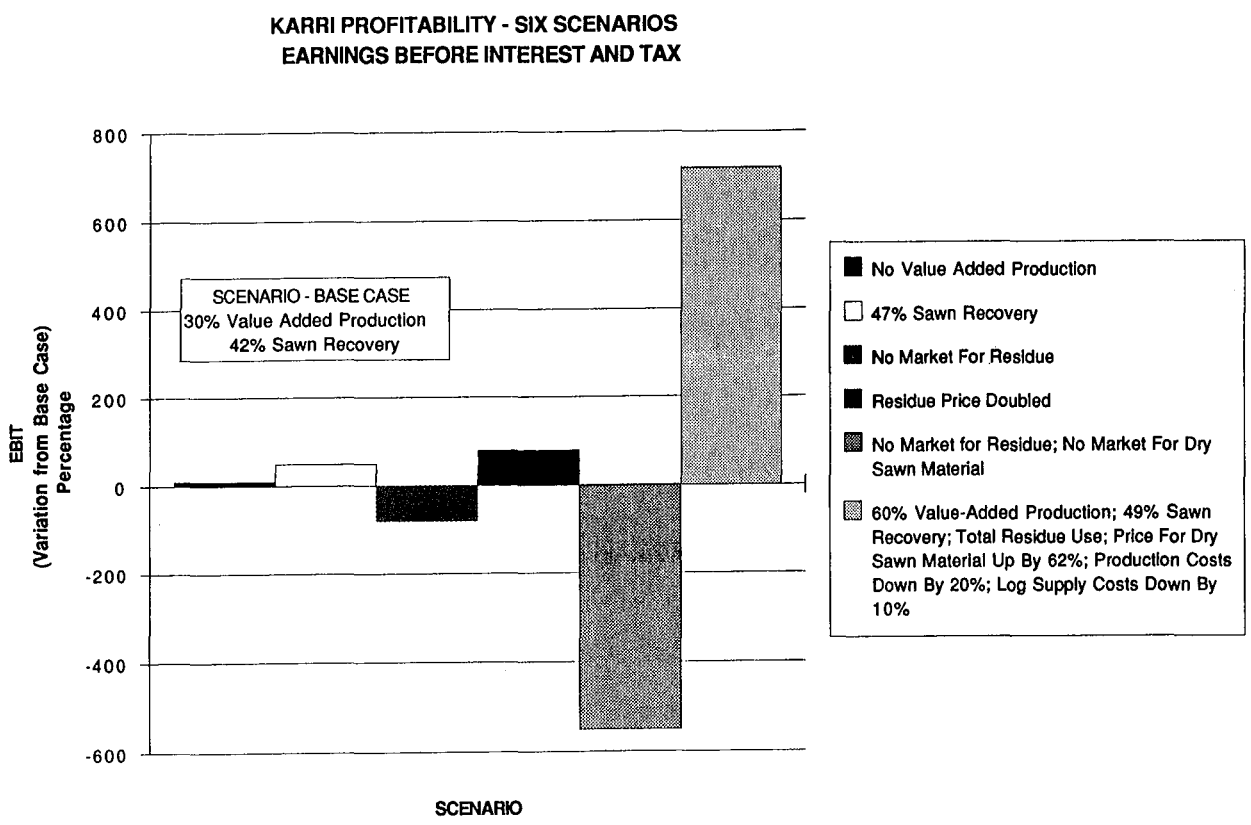


SOURCE: GROOME POYRY

Wood products derived from natural forests, if they are to reflect accurately the costs of production, must increase in price because of the relatively low productivity and long rotations or cutting cycles. Wood fibre for general purpose use will be produced from tree crops at lower costs than from natural forests. Thus if wood production from natural forest is to be a legitimate use, and if there are to be sufficient funds to pay for the cost of the sophisticated silviculture systems required, the comparative advantage of natural forest timbers, principally their decorative properties, must be exploited (Poore et al, 1989).

In Western Australia's natural hardwood forest, the transition from an industry, based predominantly on the production of green sawn structural timber, to one which produces predominantly "value added" timber products, is well advanced. Less than 10 per cent of the sawn timber produced was converted to value added products less than 10 years ago. Major sawmilling companies now produce more than 50 per cent of value added product, in part because of Government initiatives, but also because of commercial realities (Figure 7).

FIGURE 7
(Source Shea 1992)



Improving cashflow

Many farmers in Western Australia are currently facing extreme financial pressures because of the parlous state of the agriculture economy. For these farmers the promise of a cash payment of $2000 per hectare of planted trees in 10 years time is unattractive particularly if they face the prospect of selling their farms in the interim because they do not have enough income to pay current debts. CALM has developed an annuity payment system for its tree crops on farms program. Under this system the farmer is paid up to 90 per cent of his share of the proceeds from tree harvesting in the form of annuity payments. New technology which has improved efficiency, productivity (yields of between 20-40 cubic metres per annum are readily achievable) and reductions in rotation age, has meant that tree crops can yield returns of between $100-$150 per hectare per annum to the farmer for the "rent of his land" (Shea and Hewett, 1990; Shea et al, 1993).

Schemes such as this require large institutions either private or public who are not confronted with cashflow problems and who are prepared to increase the risk of their investment. (Annuities are not refundable even if the crop fails). In Western Australia, because the technology that has been developed to grow trees on farms is such that

risk is reduced, private (both overseas and Australian) and public funding has been secured for these schemes. Over 20,000 hectares of tree plantations have been established on farms in Western Australia which have involved some form of annuity payment to farmers.

Increasing and integrating uses and products

The conflict over forests is in part caused by the recognition, by an increasing number of constituencies, that forests have many uses. Ironically, one of the ways to resolve the conflict is to maximise the uses and their value, and to capitalise on the opportunities for integration.

Nature based tourism is one of the fastest growing industries in the world and forests are a prime tourist product, and the potential conflict between timber harvesting and recreational use can be avoided by appropriate dispersal of timber harvesting activities in time and space and the application of visual resource management technology (Shea and Sharp, 1993; Revell, 1991). The integration of conservation and tourist development objectives may be the only way that extinction of wildlife can be prevented (Child, 1993).

Forests can contribute numerous other non wood products (Awang and Yuan, 1993) and while these value has been relatively low in the past, their value, particularly pharmaceutical products derived from forests is potentially very high.

A significant proportion of the tree felled in timber harvesting operations in many forests is currently not utilised. Integrated utilisation of logs results in major efficiencies and increased returns (Figure 7). There are increasing opportunities as a consequence of concern about the use of non renewable resources to develop markets for a range of chemical products that can be derived from wood (Fung, 1982).

Integration of tree crops into agriculture in Western Australia, so that the financial cost to the farmer resulting from the loss of part of his farm for use for agricultural crops or grazing is eliminated or minimised, is one of the major reasons why farmers have accepted the introduction of tree crops on their farms. By strategically placing tree crops in the areas of the farm on that part of the farm which is most suited for tree growing and which confers maximum benefit by the provision of shelter to animals and windbreaks to crops it is estimated that on average 20 per cent of a farm can be planted without affecting net agricultural production. In addition, in Western Australia trees make a significant contribution to reducing the loss of farmland in valley bottoms (often the most fertile agricultural land on the farm) because they eliminate or reduce the increase in groundwater rise which unchecked causes the destruction of soils by salination (Shea and Hewett, 1990; Shea et al, 1993).

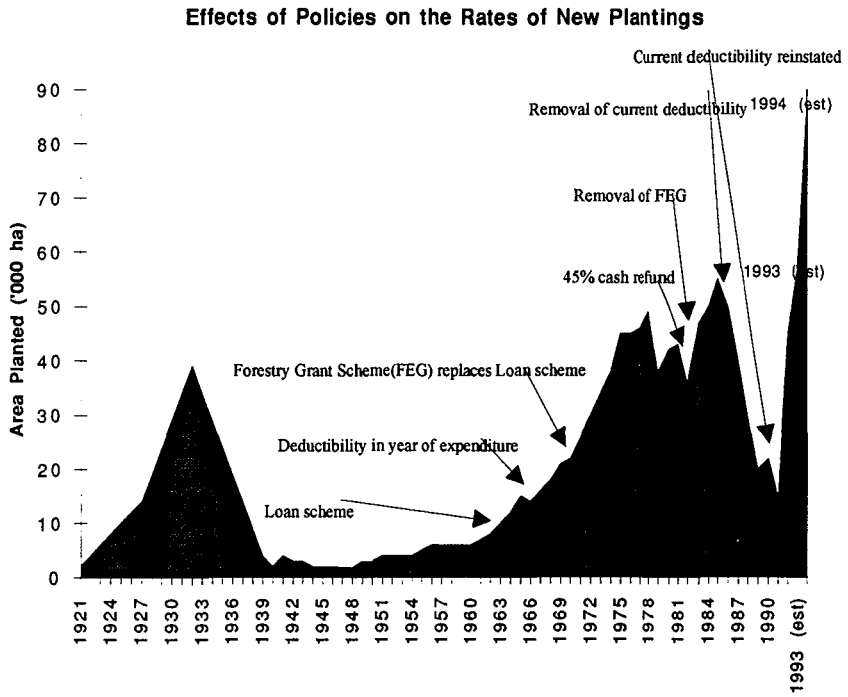
Incentives

There are legitimate reasons why some of the economic difficulties that forest managers confront in their attempts to manage forests sustainably and for multiple benefits should be addressed by the provision of incentives. For example, if the wealthy nations of the world desire to retain tropical forests to preserve their biodiversity and their carbon absorbing capacity, there is a cogent argument that they should compensate those countries whose forests contribute. There are examples where significant funds have been provided to assist management of tropical forests and existing projects have been initiated (Pinso and Moura-Costa, 1993). But given that many of these countries are not prepared to impose a requirement for

sustainability on their own forests (MacKenzie, June 1993) yet will require countries with moist tropical rainforests must meet standards of sustainability as a pre-condition to the use of tropical rainforest timber, I am pessimistic that fairness and logic will prevail and significant ***sustainable*** funds will flow to assist countries to practice sustainable forestry.

Reform of taxation systems, which often are acutely biased against forestry enterprises because they do not accommodate the long timeframes involved and the irregularities of cost inputs and revenue outputs, is one form of incentive which can have a major impact on forest values. For example, Figure 8 illustrates the potential effect of Government taxation incentives on tree plantation establishment roles.

FIGURE 8
(Source New Zealand Ministry of Forests)



ARE THERE POLITICAL, INSTITUTIONAL AND SOCIAL CONSTRAINTS WHICH PREVENT US ACHIEVING SUSTAINABILITY AND MULTIPLE BENEFITS FROM FORESTS?

Why bother with politics?

No matter how scientific and economically competent forest managers are, and no matter how precise the economic and silvicultural tools, any decision about forest management must involve a value judgement. Value judgements in our societies ultimately are made by politicians. It follows then that not only should we bother with

politics, but because politicians are higher in the decision-making hierarchy than forest managers, political skills are relatively more important than skills in biology and economics. It is ironic that the Queensland moist tropical rainforests are one of the few areas in the world where the principles of sustainable management and use have been successfully applied to moist tropical rainforests, yet it is also one of the few areas of the world where timber harvesting has been prohibited (Poore et al, 1989). It is also a powerful illustration of the fact that politics can override technical and economic excellence.

While we might bemoan the powerful role that politics play there is no other way that community values can be assessed. It is not politics that is preventing forest managers achieving sustainability and multiple use. It is the fault of those responsible for forest policy and forest management who ignore (I suspect some find it even distasteful) to acknowledge the reality and importance of the political connection.

Marketing and Communication

While there is little we can or should do about the realities of the decision-making role of politicians, we can make those decisions more likely to be compatible with the long term needs of the community by effective marketing. But marketing tends to be viewed with disdain by forest scientists and managers and is rarely incorporated into their training.

It is true that the mass media, particularly television with its penchant for 30-second grabs which frequently feature a disaster (for example a clearfelled coupe or a tree crashing to the floor to the tune of a roaring chainsaw), is not particularly suited to tell the true story about forest management. But there are other forms of communication which can be used to create a better understanding in the community of what forest ecosystems are and how they can be used. There is beginning to be a recognition that the best way to market the forest story is by direct marketing (Shea, 1992) using tools like demonstration forests (Hadley and Associates, 1989; Spriggins, 1989).

The introduction of the concept of integrating tree crops into the farms of Western Australia would not have succeeded if we had not been conscious of the need to market effectively. Farmers in the south-west of Western Australia were reluctant to accept trees as a crop. They were concerned that tree crops would disturb the social fabric of rural communities. Integrating the crops into farms addressed these concerns but the concept would have been rejected if it had not been rigorously marketed to farmers and local government authorities.

Accountability and ownership

Making the community (whether it be forest managers, politicians or special interest groups) accountable for their decisions about how we manage and use forests has always been difficult. The long term nature of forestry enterprises, their often collective ownership, the difficulty of measuring the costs and the benefits of many forest values and uses, make accountability difficult to achieve.

The existence of the "global village" has exacerbated the problem. For example, policy decisions which originate from the wealthy suburbs of European cities can have a major adverse effect on forest management half way around the world (Child, 1993).

But rational political decisions about forests will not be made until those who are directly or indirectly making the decisions are accountable.

Ownership is the easiest way to ensure accountability. Where pure ownership is not practical, which is the situation for many forests, there are a variety of surrogates to ownership which can be used to induce accountability.

For example, accountability of farmers and investors in Western Australia's tree crops on farms program has been achieved by the use of the legal technique of *profit a prendre* and by ensuring that the investors and the farmers share in the profits of the tree crops at harvest. The dramatic positive effect of conferring ownership of wildlife to villagers in Zimbabwe under the CAMPFIRE program is another illustration of the principle. (Child, 1993).

Resource security to Western Australian timber companies was provided in the form of legally binding log supply contracts. The ownership conferred by the contracts provided a major incentive to invest in the new plant and equipment required to improve utilisation and maximise the production of value-added products.

Effective communication of the actual costs and benefits of different forest uses to all the constituencies is an essential prerequisite to achieving accountability. In Western Australia there is a statutory requirement for the preparation and publication of management plans. Public participation, another surrogate for ownership, is a mandatory part of the planning process in Western Australia.

CONCLUSIONS

There is nothing new about managing forests sustainably for multiple benefits. Our predecessors, dating back before mediaeval times, sought to achieve these goals and in many forests they have been achieved. What has changed is the dramatic increase in the number of constituencies and the number of demands that these constituencies are placing on forests. These changes have created a political environment of immense complexity and intensity.

Paradoxically our knowledge of forest ecosystems is increasing exponentially and there are radical changes in the technology and economics of forest management taking place which provide the opportunity to increase levels of sustainable uses of forest to heights our predecessors never dreamed of. But to capitalise on these opportunities, forest managers must not only integrate forest management and use with the dynamics of forest ecosystems, the management and use of forests must also be integrated with the economic and political environments of the real world.

There is one certainty. Forest managers, no matter what levels of sophistication and sensitivity are achieved, will never eliminate risk or satisfy all of the forest constituencies all of the time (Kirkland, 1989). But that is the fate of any manager who seeks to optimise the use of "the commons" for the community, rather than vested interests. The challenge that forest managers must take up is to convince all the forest's constituencies, through the political processes, that they are best served by forest management that delivers the greatest good for the greatest number of people now and in the future.

The major threat to forest management progressing into an exciting era is the danger that forest managers will become weary of the critics and abdicate management

decisions to those who are not accountable and who consequently can afford the luxury of doing nothing.

For those forest managers who may be tempted . . .

> *"It is not the critic who counts, nor the man who points out how the strong man stumbled, or where the doer of deeds could have done better. The credit belongs to the man who is actually in the arena; whose face is marred by dust and sweat and blood; who strives valiantly; who errs and comes short again and again; who knows great enthusiasms, great devotions, who spends himself in a worthy cause; who, at the best, knows in the end the triumph of high achievement; and who, at the worst, if he fails at least fails while daring greatly, so that his place shall never be with those cold and timid souls who know neither victory nor defeat."*

Quoted from
John S D Eisenhower, The bitter woods (1969,
and attributed to Theodore Roosevelt.

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