CHAPTER 6: ECONOMICS OF INTEGRATED HARVESTING

INTRODUCTION

The land use zoning system in East Gippsland sets aside 578 700 hectares in reserves which are unavailable for timber production. The remaining 472 400 hectares are regarded as zones where timber production is possible with 332 600 hectares of this being zoned for dominant timber use. Such a specialised production arrangement allows analysis of timber production itself, using the net productive area of the Timber Production subzone of the General Management Zone as the boundary within which timber production takes place. Many different timber products can be supplied from a forest, making a timber production operation more complex than just harvesting a stand of trees. Those responsible for decision making at the utilisation level in East Gippsland make decisions regarding the types and quantities of timber to be produced from the timber production zone. These decisions are central to the question of how forest resources of East Gippsland are allocated.

This chapter will outline theory related joint production and use it to analyse integrated harvesting as it applies to East Gippsland.

Integrated harvesting will be defined in the context of timber operations in East Gippsland. A joint production model will be introduced and then applied to the problem of allocating forest resources amongst various timber products. Logging of the marginal hectare of forest will be examined as a problem which is particular to timber production in native forests. Finally, some production problems particular to the forests of East Gippsland will be examined.

INTEGRATED HARVESTING DEFINED

A forest produces trees of various shapes, sizes, ages and timber characteristics. There are many different uses for the various types of timber which can be obtained by harvesting the trees. Unlike a plantation, a native forest may produce a large variation in the quantity, quality and size of timber in each hectare. For example, in one hectare of native forest, there may be timber suitable for sawing, making furniture, woodchipping and the leaves can be used for oil production. Furthermore, one tree may contain timber suitable for multiple products. To harvest a hectare of forest for just one of these products could be quite expensive in terms of waste product because not all the timber would be suitable for that product. It would appear to be more efficient to harvest all trees in one operation and then distribute the timber to various end uses. This is integrated harvesting.

The term 'integrated harvesting' is commonly used to describe the harvesting of timber suitable for sawing (sawlogs) and timber suitable for pulping (pulplogs) in one operation.[247] Pulpwood is obtained from those parts of trees not suitable for sawing or from small or highly defective trees. There has been much debate surrounding the term as it is frequently associated with the clearfelling silvicultural technique and the large-scale harvesting of forests for export woodchipping.

In East Gippsland (in fact throughout Victoria), integrated harvesting is the only method by which forest can be harvested for the specific purpose of woodchipping. The sawlog-driven concept of the Timber Industry Strategy ensures that no forest in Victoria is able to be logged for pulpwood alone, it must be combined with sawlog harvesting. Export woodchip licences also stipulate that timber must be sourced from an operation which also harvests for sawlogs. The integrated harvesting process is regulated in Victoria by the log grading system which grades sawlogs according to the level of defect from A to D with an additional category Residual Log being all other timber which does not meet sawlog standards. Under the regulations, woodchips are only able to be produced from timber

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[247] Resource Assessment Commission Forest and Timber Inquiry, Commonwealth of Australia. March 1992, p. 519

harvested directly from the forest when it is classified as Residual Log. Integrated harvesting in Victoria could potentially produce up to five grades of logs from one harvest operation depending upon the composition of the particular forest site.

In order to combine the generally accepted definition of integrated harvesting with the Victorian log grading concept, integrated harvesting will be regarded as the combined production of sawlogs and residual logs from one harvesting operation.

It is the view of industry and government alike that an integrated harvesting operation is more efficient than a specialised operation for each product. While this may be generally true, it may not be true for all forest sites nor for every hectare of forest in East Gippsland. An analysis of the harvesting decision process is necessary to determine whether integrated harvesting is the optimal solution.

JOINT PRODUCTION

The theoretical concepts surrounding the general topic area of joint production will be drawn upon to analyse the optimal production of logs from the East Gippsland forest. Bowes and Krutilla define joint production as the situation where technology cannot be represented by a set of independent production functions. In effect, joint production means that some inputs are shared, having an effect on the production of more than one output.[248]

Are Sawlogs and Residual Logs Joint Products?

The physical characteristics of a native forest mean that any harvest for sawlogs will also produce some amount of residual log. Unlike a plantation, the planting and growing conditions in a native forest are largely uncontrolled resulting in a combination of tall, straight trees, crooked or diseased trees and other vegetation. Even trees which are suitable for sawlogs would produce some timber which is unsuitable for sawing. Harvesting a tree

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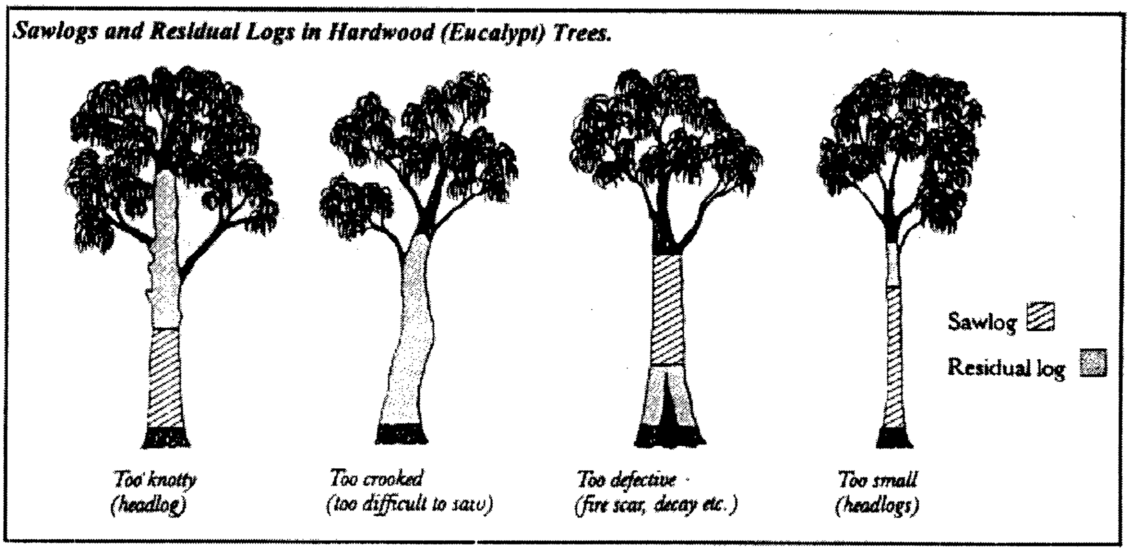
[248] M. D. Bowes, and J. V. Krutilla, *Multiple-Use Management: The Economics of Public Forestlands* Resources for the Future Washington 1989 pp. 49-50.

or a stand of trees will almost always result in the production of both sawlogs and residual logs. Figure 6.1 gives examples of how this might happen.[249]

Figure 6.1 Sawlogs and Residual Logs in Hardwood (Eucalypt) Trees



Valid use of the joint production framework requires more than a casual observation about production behaviour: "The fact that production of several outputs occur together does not necessarily indicate jointness."[250] A more rigorous test is required to rule out the possibility that sawlogs and residual logs are nonjoint products. The following test of nonjointness applies: an output is nonjoint with other outputs if its marginal cost is unaffected by changes in production levels of other outputs.[251] For this test to be proven, the marginal cost of sawlogs would have to remain constant whether some residual log was produced or no residual log was produced. There is no scope for this study to test for this precisely but it is highly unlikely that the production relationship between sawlogs and residual log would be nonjoint.

If the production is joint, there can be no unique measure of the cost of producing a single output. The cost of including one output in the overall product mix will depend upon the

[249] Department of Conservation and Natural Resources Native Forests and Woodchipping - A Victorian Perspective Information pamphlet DCNR January 1995.
[250] Bowes op.cit. p. 55
[251] ibid

level at which the other goods are provided.[252] This general statement reinforces the belief that sawlogs and residual logs are joint products. Almost every native forest harvest operation would result in the production of both sawlogs and residual log. The cost per cubic metre of sawlogs will depend upon the productivity of the forest site and the amount of residual log which needs to be incidentally harvested.

If sawlogs and residual logs are joint products, pricing and production decisions cannot be made about residual log without affecting the production characteristics of sawlogs. Regeneration, fire suppression, and roading costs would be impossible to allocate between sawlogs and residual logs except on an arbitrary basis. The cost of sawlog retrieval would almost certainly depend upon whether residual log is also harvested at the same time. Similarly, whether or not it would be viable to harvest residual log would depend upon how many sawlogs could also be harvested in the same operation.

Assumptions

Before a joint production model can be used for analytical purposes, the assumptions under which the model will be used must be stated:

1. Production is technically efficient.
2. Time frame is one year
3. Duality theory holds allowing costs to accurately represent production technology.
4. Cost is set by the government budget which is spent according to a cost minimisation strategy.
5. A forest site will be regarded as one hectare of land.
6. Each hectare represents net productive area.
7. A net productive hectare produces timber only.
8. Each hectare costs the same to harvest.
9. Land required for non-timber purposes has already been deducted in accordance with logging prescriptions contained in the Victorian Code of Forest Practice.
10. Both products carry positive value in demand.

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[252] ibid

OPTIMAL ALLOCATION OF TIMBER RESOURCES

Having decided during the planning process that some areas of the total forest in East Gippsland can be zoned for timber production only, the next decision to be made is how to optimise return from timber production from those areas. The socially optimal strategy for the Government would be to maximise profit from timber sales, given the exposure to commercial markets for timber on the demand side. Whether or not this strategy involves integrated harvesting depends upon the production relationship between sawlogs and residual logs.

An output isocost curve will be used to illustrate the supply decision facing the government. The output isocost curve represents the various combinations of sawlog and residual log production possible for the same cost. The cost represents all costs involved in producing such harvestable timber from one hectare of land, including planting (regeneration) and any other silvicultural activities. Points along the curve are technically efficient outcomes from harvesting one hectare of land. Having assumed technical efficiency, an optimal supply decision depends upon choosing a product mix which gives allocative efficiency.

Allocative efficiency is achieved by choosing the product mix which maximises profit given the revenue obtainable from the demand side. The demand side will be introduced at a later stage to draw some more accurate conclusions about the optimal product mix. The general assumption of both products carrying positive value allows some production decisions to be made without exact knowledge of the demand conditions. Figure 6.2 illustrates the joint production case of sawlogs and residual logs.

Figure 6.2 Timber Production from One Hectare

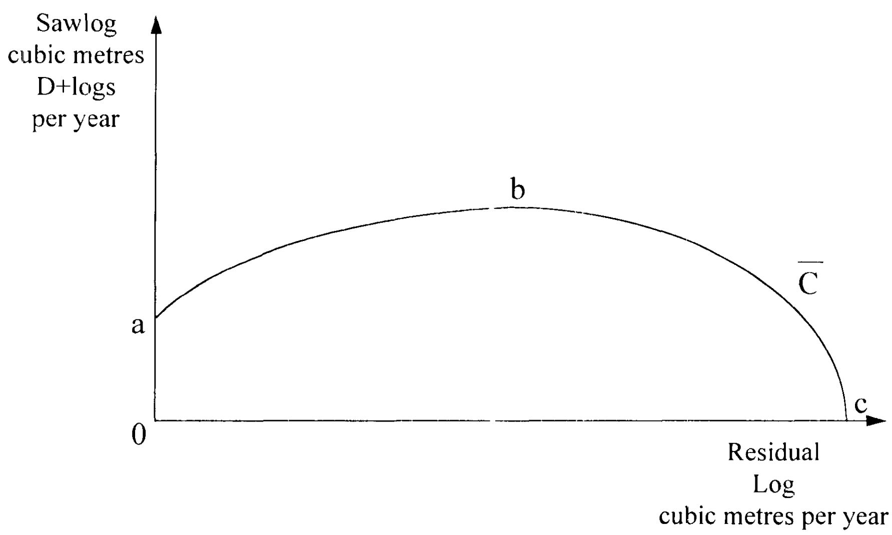


Figure 6.2 shows a mostly concave to the origin output isocost curve with an upward sloping section a-b. The upward sloping section represents some fixing of proportions due to the incidental production of residual log when sawlogs are produced. Point a shows some volume of sawlogs which is able to produced from one hectare without producing any residual log. Given the composition of a native forest, producing at point a would be quite difficult involving careful selection of trees suitable only for sawing. Over the upward sloping portion, an increase in sawlog production incidentally produces some residual log for the same cost of producing zero residual log. Alternatively, increasing residual log production will also initially increase sawlog production. Improved access for harvesting and a reduced level of care in tree selection would allow increased product for the same cost.

Point b in Figure 6.2 represents the maximum available sawlog production from one hectare of land. It possibly reflects a clearfelled site where priority is given to selection of sawlogs and the remainder graded as residual. Up to this point, it is not possible to increase sawlog production by reducing residual log production and the only way to increase sawlog production without increasing costs is to harvest residual log as well.

The downward sloping portion of Figure 6.2 b-c represents substitution of sawlogs for residual logs in production. Substitution in this portion of the curve would mean utilising some logs which have the physical characteristics of sawlogs for a residual log purpose. For example, some of the lower quality sawlogs would be chipped for export. Despite the definition of sawlogs and residual logs according to their end uses, there is no technical or physical reason why a sawlog could not be used for chipping, pulping or firewood.

Allocation of costs to sawlogs and residual logs is not possible because it is impossible to determine average costs from a joint production cost function. It is, however, possible to determine marginal costs.[253] The production relationship between sawlogs and residual logs allows marginal costs to be stated in relative terms via the cross partial derivative. That is, the marginal cost of each product depends upon the level of production of the other good. It is possible to say how the marginal cost of sawlog production is affected by a change in residual log output and vice versa.

The slope of the isocost curve gives the ratio of marginal costs, (MCresidual log /MCsawlog) which becomes steeper as the product mix moves closer to point c. This represents complementarity in joint production whereby an increase in residual log production reduces the marginal cost of sawlog production.[254] This would occur because the classification of logs between sawlogs and residual logs involves some judgement as to the quality of harvested timber. Figure 6.1 shows that there are many combinations of sawlog and residual log which are possible from a stand of trees or the same tree. Initial attempts to produce high levels of sawlogs without much residual log would involve careful selection of trees to harvest and parts of trees to classify as sawlogs. Increasing residual log production would relieve the difficulty of selection as more trees could be felled and divided into their respective categories. As substitution of sawlogs for residual log begins to occur (past point b in Figure 6.2), whole trees which previously contained some sawlog and some residual log could be merely regarded as residual log. Each progression around the isocost curve towards point c reduces the time and effort required to

[253] Bowes, op. cit. p. 54
[254] ibid. p. 57

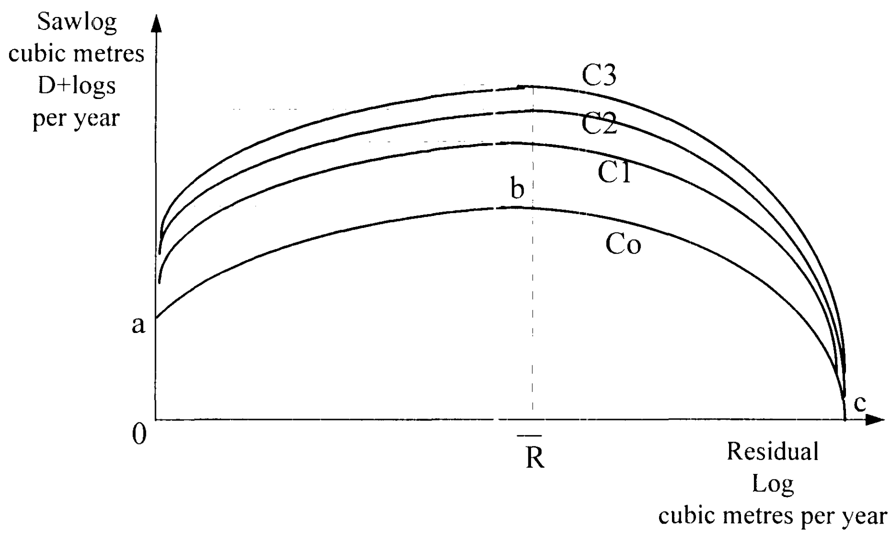
classify logs as sawlogs, thereby reducing the marginal cost of sawlog production. The concavity is also an indication of increasing opportunity costs of residual log production. Substitution of sawlogs for residual logs would be relatively inexpensive to begin with as the lower quality sawlogs could be regarded as residual log. The opportunity cost of residual log production in terms of sawlogs would increase as the product mix moved more towards residual log because more and more high quality sawlogs would be forgone.

Marginal costs of one product are able to be determined by holding the other output constant. The marginal cost of sawlog production can be derived by observing the change in costs as sawlog production is increased leaving residual log output unchanged. Increasing sawlog production from an existing point on the output isocost curve would involve moving to a higher isocost curve. Given an equal interval in cost from one isocost curve to another, the spacing of the curves would give some indication of the marginal cost of production.

Figure 6.3 shows an initial isocost curve Co. This curve may represent the costs of a forestry operation where there is minimal intervention in the growing process. Regeneration would have been quite natural with little human intervention and the growth process uninterrupted. The cost of this process is minimal as it relies on the natural growing conditions of the forest but the yield from such management is possibly also minimal. More intensive management is likely to yield a higher volume of sawlogs and cost more. For instance, managing the regeneration process more carefully by ensuring that the area is seeded or planted with the appropriate species, burning after harvest to prepare a receptive seedbed and maximise forest floor space, and monitoring the progress of the regenerating forest, would cost more than the natural alternative. This approach may even be successful at increasing sawlog yield without changing residual log yield. To increase sawlog yield again would require more intensive silvicultural practice such as thinning, fertilising and pest control.

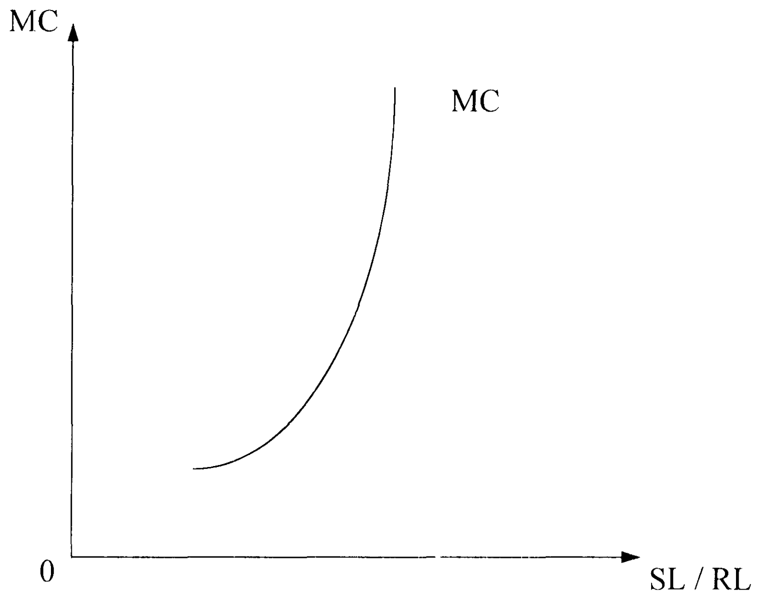
The increased silvicultural activity not only costs more but is beginning to treat the forest more like a plantation than a native forest. The isocost curve begins to change shape towards a more sawlog productive forest site than before. This means the only useful aspect of using the native forest for timber production purpose is the topographic features of the land which would have made the native forest productive in the first place. Figure 6.3 shows that the isocost curves C2 and C3 are relatively close together indicating that it would be quite costly to try and increase sawlog production too much beyond that which is provided by the native forest in its natural state. The distance between Co and C1 is a little further, perhaps indicating some improvement in productivity given some mild intervention in the growing process.

Figure 6.3 Deriving Marginal Cost of Sawlogs



The marginal cost of sawlog production can only be measured while holding residual log constant. Figure 6.3 shows that increasing cost by an equal amount each time between Co, C1, C2 and C3, results in declining marginal increase in sawlog production when residual log is held constant at R. This translates to rapidly increasing marginal costs with each equal increase in sawlog output. The large rise in cost is particularly noticeable after hitting C1 in Figure 6.3, where it would become very expensive to increase sawlog output from the same hectare of land, keeping residual log constant. The result in a partial equilibrium framework would be a very steep upward sloping marginal cost curve such as that shown in Figure 6.4.

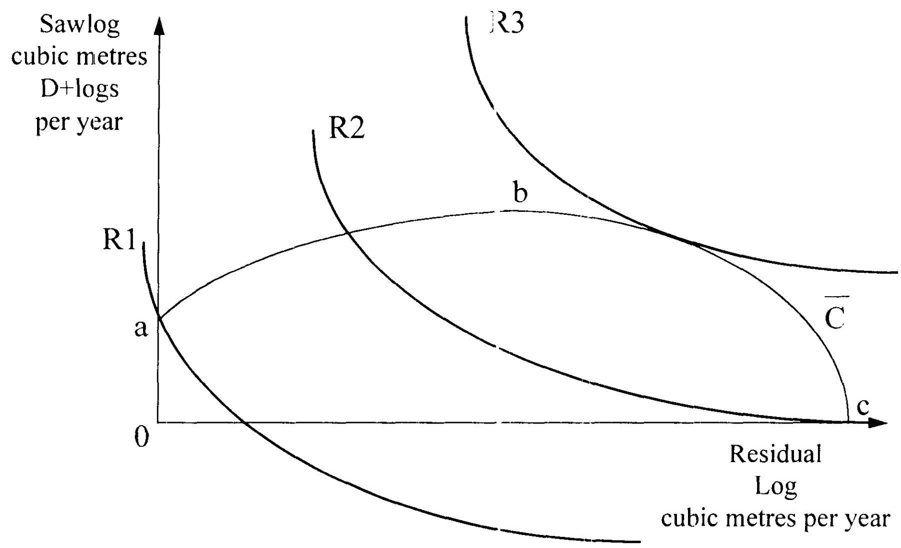
Figure 6.4 Marginal Cost of Sawlogs



Integrated or Specialised Harvesting?

The profit motive will cause the owners, (Government in this case), to choose the least cost alternative of integrated or specialised harvesting. With the general assumption of positive value of both products in demand, a cost minimising position in Figure 6.2 would be some mixture of sawlogs and residual logs. The assumption of positive values in demand rules out the possibility of sawlog only production being optimal because the resulting isovalue curve must be negatively sloped. A negative value for residual log giving a positively sloped isorevenue curve would be necessary for an optimal sawlog-only solution. If the positive value assumption is valid, it can be concluded that integrated harvesting is a more efficient outcome than sawlog only harvesting on each hectare of land. Figure 6.5 illustrates that a higher level of revenue can be achieved for the same cost by producing at some combined output rather than specialisation.

Figure 6.5 Optimal Integrated Harvesting



Each isovalue curve in Figure 6.5 (R1, R2 and R3) indicates the combination of the two products given equal value by the community. In this case the community is the East Gippsland timber industry and the value is represented in commercial terms by demand for sawlogs and residual logs. Demand for logs would be derived from demand for processed product such as kiln dried sawn timber or woodchips and subsequently from the demand for housing and paper respectively. In this case, both products potentially have some commercial value and the value attached to each can be measured in terms of revenue. The isovalue curve can therefore be regarded as an isorevenue curve. The shape of the isorevenue curves is determined by the competitive market situation for the products.[255] Perfect competition in both markets would give linear isorevenue curves with the slope being the ratio of marginal revenues which is equal to the ratio of output prices. The Department of Natural Resources and Environment is the sole producer of sawlogs and residual logs in East Gippsland. There are many buyers of sawlogs and localised nature of sawmills means that distance is a barrier to other regions competing with East Gippsland. Although the Department is the only supplier of residual log in East Gippsland, the market

[255] Gregory, G. Robinson *Resource Economics for Foresters* John Wiley and Sons, New York 1987 p.137

for residual log is not as limited by geography, with potential buyers mostly located out of the region and therefore also able to buy from other sources. Market power over the residual log market is not as clear as for the sawlog market. Being unsure of the extent of market power in both markets, it would be reasonable to assume that neither markets are perfectly competitive and therefore the isorevenue curves are unlikely to be linear and parallel. The convexity of the curves indicates a reduction in marginal revenue as more of each one of the products is sold.

Timber industry representatives (both private sector and government) have been arguing for integrated harvesting on economic grounds for many years resulting in the practice being legal and subject to encouragement over the past seven years. Although it is easy to agree that integrated harvesting is preferred to sawlog-only harvesting, there are some complicating factors which make the decision of exactly how much of each product to produce more difficult.

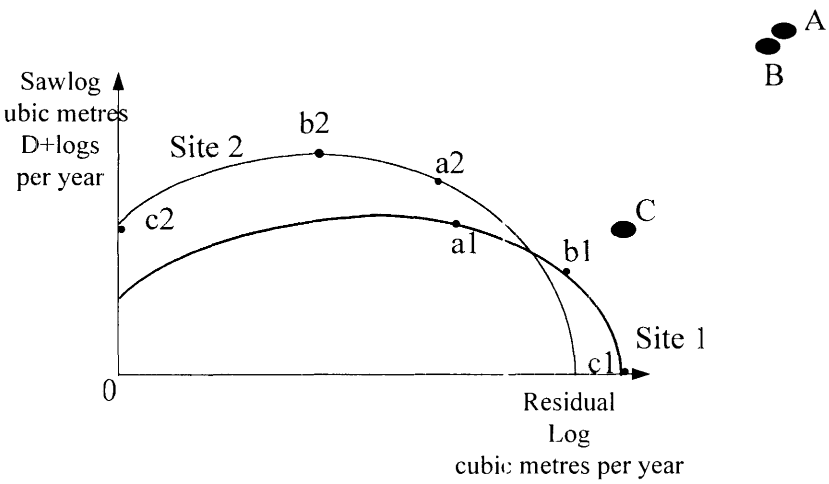
The Whole Forest Area

The whole forest area is made up of a mosaic of forest sites, each having potentially different characteristics. In particular, not all forest sites are equally productive in timber production nor sawlog or residual log production. The production scheduling decision when considering the whole forest is not just a matter of dividing the required volume by the number of available hectares of forest or even by the standing volume of forest.

In any one year, timber producers must decide how many and which sites are required to produce the timber demanded. The joint production model used in Figure 6.5 does not lend itself to aggregation. Furthermore, each hectare of forest has potentially different characteristics, limiting the ability to aggregate information and use the model for decision making purposes. A deeper understanding of the harvesting decision making process can be obtained by comparing one forest site to another.

The decision to integrate harvesting is favoured by economies of jointness, by diseconomies of scale and by few differences in site productivity.[256] Economies of jointness is illustrated in Figure 6.2 by the concavity of the output isocost curve and the technical implications that this has from the model specifications. The shape of the output isocost curve gives information about the production relationship between sawlogs and residual logs. Economies of jointness are represented by a negative cross partial derivative C_{rs}, illustrating that the marginal cost of sawlogs will fall as production of residual log increases. This is what produces the concave shape although it is noted that concavity does not automatically imply economies of jointness.[257] Perhaps a more intuitive explanation is that the total cost of integrated production will be less than the combined separate production: $C(Q_r + Q_s) < C(Q_r) + C(Q_s)$ when there are economies of jointness.[258] This means that it would cost less to harvest both residual log and sawlogs in one harvest operation on each forest site than to harvest sawlogs from one site and residual log from another site. To test this, Figure 6.6 shows a case of differing site productivity.

Figure 6.6 Differing Site Productivity



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[256] Bowes, op. cit. p. 64
[257] ibid. p. 61.
[258] ibid.

Figure 6.6 shows two concave output isocost curves, each representing a separate forest site and each having differing productivity. Site 1 is more productive in residual log relative to Site 2 which is more productive in sawlogs. Three output combinations are given. Output combination A which reflects approximately even production of both goods at each site produces at a1 on Site 1 and a2 on Site 2. Allowing each site to specialise in its comparative advantage product will see the product mix at Site 1 move towards the horizontal axis and the product mix at Site 2 move towards the vertical axis to points such as b1 and b2. The resulting combined output is represented by point B. It will be cost minimising for each site to specialise until the ratio of marginal costs at each site are equal. For example: if Site 1 specialised in residual log production further than this point, the marginal cost of residual log would then be higher relative to what was available at Site 2. The same could be said of Site 2 specialising further in sawlog production. To illustrate this suboptimal position, points c1, and c2 show how complete specialisation would give a combined production of C which is far inferior to points A or B.

Figure 6.6 shows that economies of jointness represented by concavity of the curves makes integrated harvesting preferable to specialised production even when there is a difference in site productivity. Quite large differences in site productivity would need to occur in order for the site differences to override the economies of jointness and make specialised production cost minimising. The upward sloping portion of the isocost curves certainly rules out complete specialisation of one site in sawlogs but does not preclude the case where it would be optimal for one site to completely specialise in residual log. Figure 6.7 illustrates this possibility.

Figure 6.7 Specialised Production

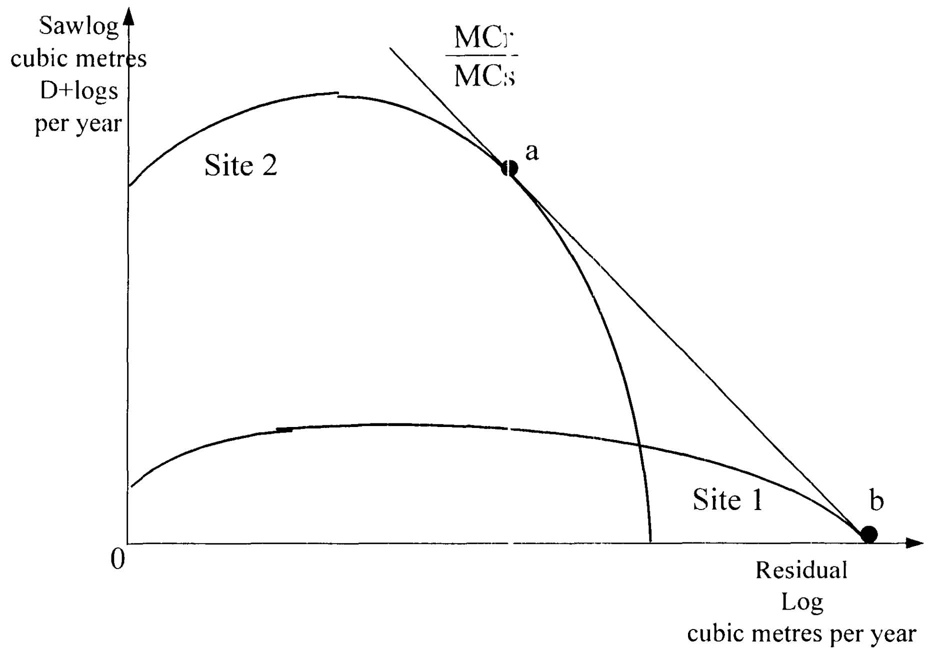

Figure 6.7 gives an example of where specialising Site 1 in residual log production would be cost minimising. Points a and b exhibit the same ratio of marginal costs indicating that no rearrangement of product mix at each site would result in a better combination of residual logs and sawlogs for the combined cost of Site 1 and Site 2.

The conclusion drawn from Figure 6.7 presents an additional complication which indicates that allocative efficiency is still not achieved. There are several other points in Figure 6.7 where the ratio of marginal costs would be equal. The measurement of which point is best lies with the relative demand for sawlogs and residual log. A combination which results in higher sawlog and less residual log could be superior if consumers prefer sawlog to residual log. Figure 6.8 shows how the shape and position of the isorevenue curves will determine which production combination is allocatively efficient.

Figure 6.8 Different Isorevenue Curves

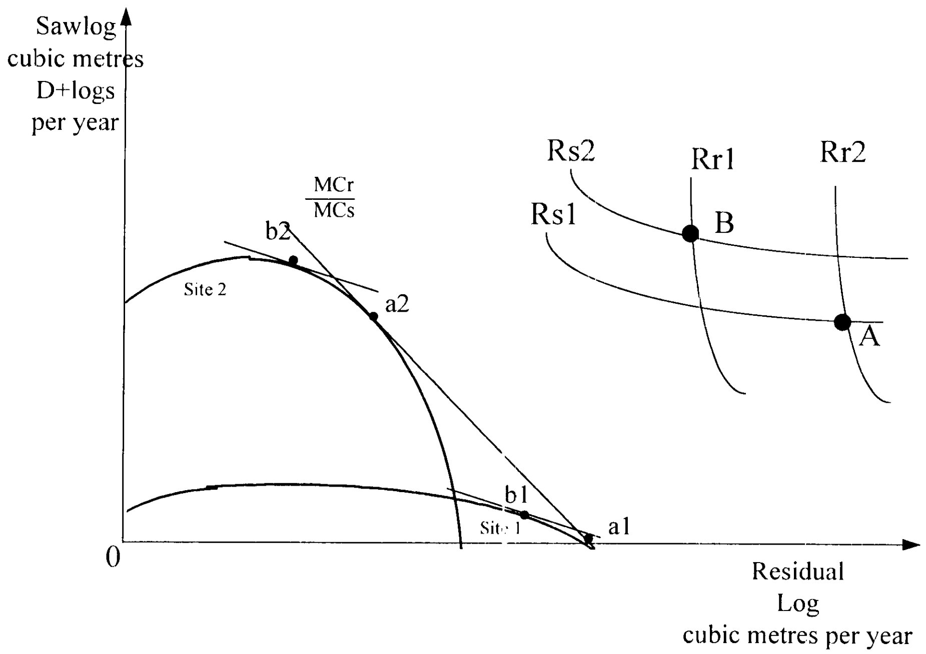

Figure 6.8 compares two cost minimising positions, a1 and a2 to b1 and b2. The resulting combined production is represented by points A and B. The two sets of isorevenue curves are labelled Rs and Rr. The steep set are labelled Rr and represent the situation where residual log is highly valued relative to sawlogs, resulting in a high ratio of marginal revenue for residual log relative to marginal revenue for sawlog. The flat set of isorevenue curves are labelled Rs indicating a low ratio of marginal revenue for residual log relative to sawlog and the fact that sawlog is more highly valued than residual log. Figure 6.8 shows that if the Rs curves represent the demand situation, then the b combination of production will be optimal because combined production B falls on the highest isorevenue curve. If isorevenue curves Rr prevail, then production combination A will be optimal.

Figure 6.8 adds confidence to the conclusion that integrated harvesting is optimal. For specialisation of a site in residual log production to occur, not only must the site productivities be quite different in order to override the economies of jointness but the isorevenue curves must reflect that residual log is highly valued.

The actual marginal revenue received for sawlogs and residual logs in East Gippsland varies according to the mix of sawlog grades harvested, the distance of the site from a royalty determination point, and the price obtainable by tender for residual log. The royalties collected represent the stumpage value of the timber because all logging and transport costs are paid by the wood processors. The Department of Natural Resources and Environment also collects a roading charge on each cubic metre of timber taken from the forest. Set royalties for the Orbost District in the East Gippsland Forest Management Area in 1996/97 vary so widely that it is almost impossible to select representative royalties. Taking the most commonly harvested species for sawing and disregarding the distance allowance of the royalty scheme, the following approximate royalties apply[259]:

Log Grade	Mountain Ash Species	Other Species
A	$70.00	$54.00
B	$38.00	$30.00
C	$24.00	$22.00
D	$ 5.40	$ 5.40

There are no set royalties for residual log because it is sold by tender. Past revenues have ranged from $0.10 per cubic metre to $15 per cubic metre.[260] In reality, residual log would not be expected to return more than a D grade sawlog unless demand conditions were particularly strong for residual log. Very few A and B grade logs are harvested as a proportion of the total yield from any forest type. Using the C grade log royalty as a proxy for the sawlog price and the D grade sawlog royalty as a conservative estimate of the residual log price, the ratio of marginal revenues (MRr/MRs) would be approximately 0.2.

[259] Department of Natural Resources and Environment Summary of Royalties for the Orbost District in the EGFMA for 1996/97.
[260] pers. comm. Gary Featherston Department of Natural Resources and Environment Orbost 14-1-97

Despite the approximate nature of the calculation of marginal revenue ratios, it shows that the isorevenue curve is more likely to be shaped like the Rs set in Figure 6.8 than the Rr set. The combination of the shape of the isocost curves and the demand conditions for the products means that integrated harvesting of sawlogs and residual logs on each forest site is most likely to be optimal.

THE MARGINAL FOREST SITE

Given that forest has been set aside for timber production and that integrated harvesting is the optimal strategy, the whole forest area could be scheduled for harvest in accordance with forest management objectives. The manager of a native forest may face an additional decision when trying to maximise profit from timber production: Whether to harvest the additional hectare of forest at all. Zoning of the area for timber production doesn't give a guarantee that the harvest operation will be commercially viable.

Profit maximising behaviour suggests that the marginal hectare of forest will be harvested if the benefits outweigh the costs. In particular as Gregory points out, "the operator must decide whether the additional costs involved turning trees.... into saleable lumber will at least be covered by the additional revenue created by these actions. If so, and if existing opportunity costs have been included, the timber should be acquired."[261]

The above analysis concluded that isorevenue curves for East Gippsland forests are likely to be fairly flat, similar to those labelled 's' in Figure 6.8, indicating a stronger preference for sawlogs than residual logs. Applying this information to the marginal forest site decision means that sites which are more sawlog productive will be harvested before those that are relatively more residual log productive.

Figure 6.9 illustrates various forest sites, each being capable of producing various combinations of sawlogs and residual logs.

[261] Gregory, op. cit. p. 120

Figure 6.9 Harvest Scheduling

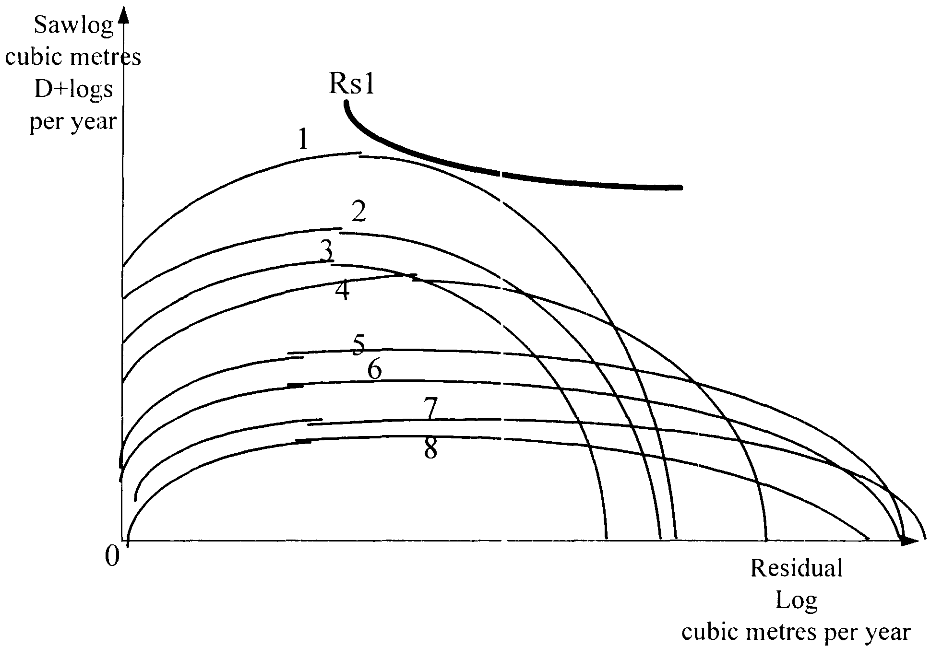

Figure 6.9 illustrates eight different forest sites, each giving a different output result for the same cost as represented by the output isocost curves. The isorevenue curve Rs1 is taken from figure 6.8. Although each site will cost the same to harvest, revenue collected will be much higher for sites which are more sawlog productive. Consequently, sites such as 1, 2, 3 and 4 will be selected for harvest in preference to sites such as 5, 6, 7 and 8. This is a relative decision. Sites which are absolutely more productive in both sawlogs and residual logs will only be preferable if they relatively more productive in sawlogs.

Once the higher sawlog productive sites are harvested, they will not be replaced for the next 80-120 years, forcing the forest operator to consider the lower productive sites for harvest. Even the lower productive sites will be harvested as long as the revenue covers the cost.

The cost of harvesting each forest site would be much the same across the whole forest area, the revenue received for the harvest would vary according to the quality of logs sold.

Gregory points out that: "Neither tree nor log grade have a very significant effect on cost, but the effect on revenue is pronounced."[262]

In the long term planning position, a forest manager would make a decision about the marginal hectare by comparing discounted revenues to the regeneration costs plus rental on the land. Despite this relatively simple solution, market conditions, prices, the forest structure and composition can alter over the life of a forest stand to change its viability status. If the viability of a forest site is decided exogenously along with the rotation age at one point in time, the forest manager could be faced with a situation where the profit maximising rotation has been reached but the hectare of forest is no longer viable. At this point, the costs of growing the forest have already been incurred and a loss recorded to that extent. Not harvesting will mean that the existing loss is incurred and will prevent the regeneration of a new forest stand. Harvesting will only be the profit maximising option if the revenue obtained more than offsets the costs incurred in actually harvesting. That is, those costs incurred in addition to the sunk costs of growing the trees.

The decision to harvest and regenerate a site which is not considered to be viable, would carry with it the condition that the future forest stand would be viable over the long term: that the discounted revenues covered the regeneration cost. If this is not likely to be the case, then the suitability of the land for timber production would come into question. Other land use options such as agriculture or conservation should be considered.

CONCLUSION

Timber products are jointly produced via the integrated harvesting process in East Gippsland. Integrated production will most likely be preferred to specialised production for timber using efficiency criteria. Current log prices indicate that sawlogs carry higher value in consumption than residual log providing incentive for high sawlog productive forest sites to be harvested prior to lower sawlog productive sites. There are also likely to be

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[262] ibid. p. 117

cases where a forest site should not be harvested on economic grounds at all but should be put to an alternative use. Allocation of timber products from East Gippsland's forests is currently extremely difficult due to the institutional setting within which the timber industry operates and past logging practices.

CHAPTER 7: IMPACT OF INSTITUTIONAL ARRANGEMENTS ON FOREST RESOURCE USE IN EAST GIPPSLAND

INTRODUCTION

The timber production process in East Gippsland is clearly divided into the management (planning) phase and the utilisation phase. A combination of market failure, political compromise and traditional forestry practice has resulted in an institutional framework which influences decision making at both management and utilisation levels of forest use.

This chapter will evaluate the institutional arrangements used to allocate forest products in East Gippsland using the socially optimal outcomes suggested by economic theory.

As the central focus of forestry in Victoria, the sawlog driven concept will be explained and tested against efficiency criteria. The timber pricing system currently in place will be critically evaluated, as will the current forest management guidelines of sustainable yield. Forest resource use problems which have arisen from past logging practice and current institutional arrangements will be explained. Finally, the economic solution to the problems associated with integrated harvesting will be explained and illustrated.

SAWLOG DRIVEN CONCEPT

Current forest management and utilisation for timber follows the sawlog-driven concept of the Victorian Timber Industry Strategy.[263] All planning and utilisation aims to maximise sawlog production and at all times retain sawlogs as the focus for harvesting. The sawlog-driven concept specifically rules out the possibility of forest being harvested for residual

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[263] Victoria Timber Industry Strategy Government Statement August 1986 p.6

log only and the possibility of higher quality logs being used for a lower quality processing. Sawlog quality logs cannot be processed as woodchips from a Victorian forest. The sawlog-driven concept is mainly administered by the log grading system which ensures that only logs not meeting sawlog criteria can be classed as residual log and used for woodchip production.

The log grading system places a constraint on the allocation of logs from the forests of East Gippsland by fixing the proportion of sawlogs to residual logs at maximum sawlogs in each forest site. Figure 7.1 draws on theory from Chapter 6 to illustrate the implications of the log grading system.

Figure 7.1 Log Grading

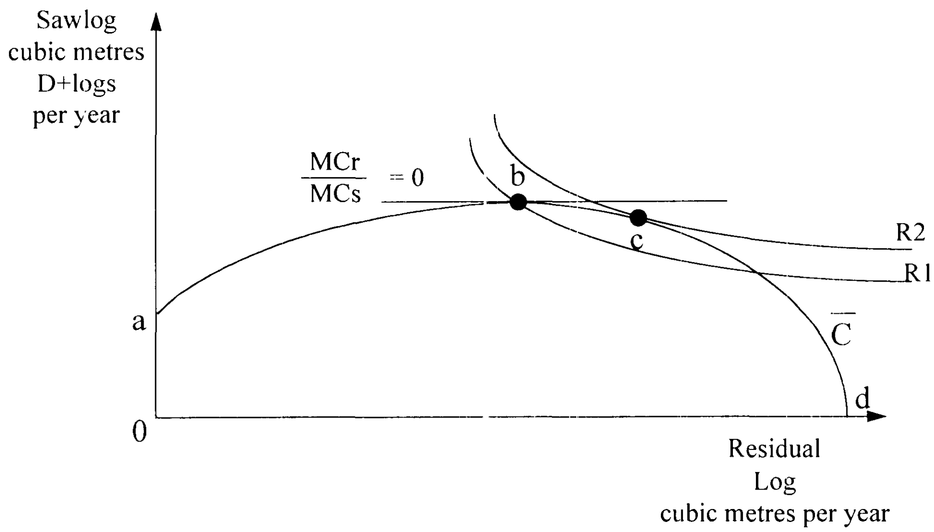

Figure 7.1 shows that the technically and allocatively efficient mix of products occurs where R2 is tangent to the output isocost curve at point "c". This solution depends on both sawlogs and residual logs carrying some positive value in consumption giving downward sloping isorevenue curves. The log grading system fixes the output mix at point "b", giving the maximum possible sawlog with no possibility of sawlog quality logs being classified as residual logs. The outcome is that the revenue collected for the mix at point

"b" is less than that which could be collected at point "c" on the higher isorevenue curve R2.

Figure 7.1 also gives some explanation about the incentive for the log graders to down grade the logs. At point b the marginal cost of residual logs relative to the marginal cost of sawlogs is zero. If the producer of the logs (Department of Natural Resources and Environment) is unable to control what the logs are used for and if the buyer has a licence for various grades of logs, there would be incentive for the buyer to pay very little to cover the zero marginal cost while actually gaining positive value from the residual logs. If this exercise was completed for combinations of various log grades from A to D, the same conclusion could most likely be drawn about the incentive to down-grade the logs. Furthermore, the current practice of policing the log grading system for prevention of down grading is costly and a would most likely result in technical inefficiency. "The production unit is said to be technically inefficient if it operates on the interior of its production possibilities set."[264] This means that the firm is not using its inputs to produce outputs in an optimal manner and is therefore underproducing outputs and/or overusing inputs. Administering the log grading system uses labour resources which could be better used for timber production if the product mix was determined by marginal cost pricing. Point b in Figure 1 is then more likely to be inside the isocost curve than on it, and tangent to a lower isorevenue curve than R1.

A more efficient outcome could be achieved by abandoning the log grading system and allowing each log to be used for its highest value purpose. As can be seen from Figure 7.1, the solution would be close to point b because the current price ratio of sawlogs to residual logs favours sawlogs. The argument that sawlogs would be chipped has little substance when the incentives for utilisation are considered. The highest bidder for an A grade quality sawlog is surely going to be a sawmiller rather than a woodchipper. A woodchipping company would not pay a very high price to produce a very low value product. The Harris-Daishowa (HDA) woodchip company estimates that the basic woodchip raw material cost is around $340 per tonne of paper produced. Since it takes

[264] Knox Lovell, C.A. and Sickles, Robin C. Testing Efficiency Hypotheses in Joint Production: A Parametric Approach The Review of Economics and Statistics Volume LXV 1983 p 52 pp 51-58

approximately four green tonnes of woodchip to produce one tonne of paper, the price received for one tonne of woodchips would be $85 per tonne.[265] After subtracting processing costs, transport from the forest to the mill and from the mill overseas, the residual price which HDA would be prepared to pay for logs would be somewhat less than this. The current royalty for an A grade log ranges from $70.46 to $33.35 per cubic metre.[266] With a cubic metre of timber approximately equivalent to a tonne of timber, woodchip companies would have incentives to utilise lower quality and lower priced logs prior to purchasing higher quality logs.

The log grading system also prevents the forest from responding to changes in market conditions, which is possible when each log can be allocated according to the value of its marginal product. If, for example, woodchips became very valuable in the future, it is possible that a woodchip company would be prepared to pay a higher price to chip a higher quality log. The shape of the isorevenue curves would be steeper and more sawlogs would be utilised for residual log purpose. Regardless of the end use, the producer, (Department of Natural Resources and Environment), would receive the maximum revenue for its product.

SAWLOG ROYALTIES

The Royalty Equation System currently used to determine sawlog royalties also harbours inefficiency. The system subsidises the transport costs of sawmillers by discounting the sawlog royalty according to the distance from the coupe to the mill. This subsidisation would lower the revenue obtained for sawlogs relative to the marginal cost of production when the log grading system is in place. This is illustrated in Figure 7.1 at point b, where the ratio of marginal costs is zero (MCr/MCs = 0) while the ratio of marginal revenues is higher as could be read from isorevenue curve, R1. As previously stated, point b in Figure 7.1 is allocatively inefficient. It could therefore be concluded that sawlog production at point b is somewhat subsidised by residual log production which attracts a higher than zero

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265 Harris-Diashowa (Aust) Pty Ltd Some Background Information about Harris-Diashowa (Aust) Pty Ltd.
266 Department of Natural Resources and Environment, *Summary of Royalties for the Orbost District in the EGFMA for 1996/97.*

value in consumption. While subsidisation of transport costs encourages consumption of sawlogs, it discourages production of high quality sawlogs, particularly those situated some distance from the sawmill. The allocative effects are important but the most significant source of inefficiency surely must be the monitoring and measuring of distances from coupe to mill and the subsequent charging of appropriate royalty rates. As with the log grading, such administration activities would result in technical inefficiency and a production point somewhere inside the isocost curve.

Marginal cost pricing at the stump would facilitate log allocation to its highest value and reduce costs of administering the royalty equation system. Forest sites which are some distance away from the mill would be less attractive to those utilising forest products, possibly giving them a comparative advantage in conservation.

SUSTAINABLE YIELD

The sawlog-driven concept extends beyond forest utilisation to the planning stage of forest management. The legal allowable harvest yield is stated in terms of sawlog volume per year. The drive to maximise annual sawlog yield is translated into the sustainable yield calculations which give the maximum allowable yield of sawlogs able to be harvested from the forest each year.

The forests of East Gippsland are managed using sustainable yield criteria, which is distinguished from the traditional forester's 'sustained yield' by definition: A sustainable yield is one that is capable of being sustained but not necessarily one that is sustained."[267] The 'sustainable yield' in East Gippsland is currently 'sustained' because long term sawlog licences (15 year) have been issued to the full amount of the annual sustainable yield allocation. Under these licence commitments, the Government is not at liberty to reduce allocations unless unforseen circumstances such as wildfire occur, thus making the distinction between sustainable and sustained yield irrelevant in the short term.

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[267] Ferguson, I.S. Report of the Board of Inquiry into the Timber Industry in Victoria Volume One Report June 1985 p. 118

Neither the total area harvested each year nor the volume of residual log harvested are subject to any legal constraints. Foresters are free to schedule as much forest as is available and necessary each year to meet the commitments of licence holders as long as the volume does not exceed the annual sustainable yield.

Volume Licences

The sustainable yield calculation combined with the Victorian State Government's commitment to the sawlog industry via its Timber Industry Strategy provides for long term sawlog licences. These 15 year licences give no entitlement to a particular area of forest but give a commitment that the State will supply a certain volume of sawlogs to the licence holder. Due to the long term nature of the licences, the sustainable yield maximum annual harvest also becomes a minimum sawlog commitment which the State must meet given the available resources. The sustainable yield for the East Gippsland Forest Management Area is 250 000 m^3/year of D+ net sawlog.[268] The licensed volume for the EGFMA 1996/97 Harvesting Season is 196 365 m^3 of D+ net sawlog and 88 110 m^3 of D+ gross sawlog.[269] With a conversion rate from gross to net being 0.73 for D-grade sawlogs and 0.87 for C-grade sawlogs, the gross sawlog allocation converts to 65 148 m^3 of net sawlog. Adding this to the net sawlog allocation gives a total licensed volume of 261 513 m^3 of D+ sawlog in 1996/97.[270]

The volume licences are based on the volume of sawlog available from the total forest management area. No consideration is given to the quality composition of each forest site and therefore the viability of each site from a utilisation perspective.

Rotation 80-120 years

The sustainable yield calculations are based on volume projections of various forest types. It has been assumed that the maximum annual sawlog yield will be possible from Alpine

[268] DNRE Review of Sustainable Sawlog Yield East Gippsland Forest Management Area Forest Service Technical Reports 96-2 p. 23

[269] DNRE Intended Product Volumes by Licensee in the EGFMA for the 1996/97 Harvesting Season to meet Licence commitments.

[270] DNRE Intended Product Volumes by Licensee in the EGFMA for the 1996/97 Harvesting Season to meet Licence commitments. Personal communication with Gary Featherston DNRE Orbost.

Ash, Mountain Ash and Shining Gum, Mountain Mixed Species and Foothill Mixed Species forest types with 80 years of growth. The rotation age for Coastal Mixed Species and Alpine Mixed Species forests is 120 years reflecting the slower growing nature of this forest type. These rotation ages reflect nominal (or ideal) growing periods which may need to be adjusted to achieve a balanced age class across the whole FMA. "The minimum harvest age is 65 years for all forest types except Coastal and Alpine mixed species where it is 85 years and thinned Foothill Mixed Species forest where it is 55 years of age."[271]

Past Logging Practice

Through the first half of this century, the forests of East Gippsland were selectively logged for high quality timber to be used for railway sleepers. The East Gippsland Statement of Resources, Uses and Values confirms this: "During the postwar years, 500 000 to 600 000 sleepers were cut each year."[272] Selective logging involved harvesting the trees which met the quality criteria and leaving unsuitable trees standing. Forests were cut over initially for Red Ironbark but the list of acceptable species gradually increased as the demand for sleepers increased.[273] The main impact of this practice was that no seed trees were left to regenerate the harvested trees and the trees remaining would have impeded regeneration had attempts been made to plant or seed the area. The species of trees deemed unsuitable for harvesting at the time were then given the opportunity to take over that part of the forest. Over time, selective harvesting has changed the composition of these forest types resulting in a larger volume of lower timber productive forest. [T]he selection systems that were employed, and the fact that there was little or no regeneration effort, meant that much of the coastal and foothill forest today is depleted of durable species and Silvertop and White Stringybark now dominate.[274]

The method of regeneration used for native forest depends on the harvest technique, the type of forest, the cost of regeneration and environmental factors. The main regeneration methods used in East Gippsland today are clearfelling and seedtree methods. Both of these

[271] DNRE Review of Sustainable Sawlog Yield East Gippsland Forest Management Area op. cit. p. 31
[272] Department of Conservation and Natural Resources, *East Gippsland FMA - Statement of Resources, Uses and Values*, Melbourne, January 1993 p. 7
[273] ibid p. 7
[274] ibid p. 6

involve felling most of the trees in the stand (including poor quality) and burning to reduce fire risk and provide a receptive seed bed.[275]

In the past, selective logging techniques allowed for little or no utilisation of trees with poor form or undesirable wood properties and little or no effort was expended on creating a receptive seed bed.[276] Even after it was recognised that regeneration was necessary, the techniques used were not as successful as those used today. Rehabilitation projects have been undertaken in East Gippsland to restock forest sites where regeneration was not undertaken or where it failed.[277]

The Proposed Forest Management Plan outlines the result of past long practices: "Since the 1960s, timber harvesting has been concentrated in the more productive high-elevation forest types. Large areas of mature stands of these forest types were also included in the Snowy River and Errinundra National Parks in the 1980s. Consequently, State forest contains a disproportionate amount of regrowth in the net productive area in these forest types. On the other hand, the mature and overmature forests from which the sustainable-yield commitments are to be met include a disproportionate amount of low-elevation forests that yield low volumes of timber."[278] This means that many high yielding coupes are now unavailable for logging and will not be available until significant regrowth matures in 20-30 years time.[279]

The given rotation age of the forest results in a maximum annual yield which ensures the long term timber productivity of the forest (sustained yield). Overcutting means that this maximum yield has been exceeded thus relying on future harvest scheduling to correct the problem. Department of Natural Resources and Environment resource information indicates that the long term sustainable yield (LTSY) average yield is 49 m^3/ha of D+ grade sawlogs. A review of recent years' utilisation indicates that average yield has been

[275] ibid p. 143
[276] ibid p. 145
[277] ibid p. 146
[278] CNR Proposed Forest Management Plan East Gippsland Forest Management Area Conservation and Natural Resources February 1995 p. 38
[279] DNRE Review of Sustainable Sawlog Yield East Gippsland Forest Management Area op. cit. p. 17

approximately $75m^3$/ha of D+ grade sawlogs, leading to the conclusion that overcutting is occurring.[280]

FOREST RESOURCE USE PROBLEMS

Harvest Scheduling

The combination of past logging practice, long rotation periods and the long term sawlog licensing means that high yielding regrowth forest will not be available for harvest until the year 2018 with significant volumes unavailable until 2040.[281] Available to meet the current sawlog licence commitments is 225 548 hectares of mature and overmature forest mainly from the Foothill Mixed Species and Coastal Mixed Species forest types.[282]

The Forest Management Plan for East Gippsland recognises the heavy reliance on low elevation forests types and addresses this by implementing a management guideline: "Each forest type in the FMA will be harvested at a rate enabling a relatively even flow of logs of different species and grade to be maintained."[283] The plan also recognises the difficulty of this task: "Application of this guideline will shift the general emphasis of timber harvesting towards low elevation forests, that yield lower volumes of sawlogs, for the next 30 years or so. It is stressed that this is an ideal scenario to guide managers. Numerous factors may make it difficult to meet these targets, foremost being the availability of markets for residual logs."[284]

The Department of Natural Resources and Environment is currently in the difficult position where it needs to supply the licensed volume of sawlogs from forest sites of low sawlog productivity. Such harvest scheduling will incidentally produce approximately 650 000 m^3 of residual log per year which is the current focus of the Department's utilisation plans.

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[280] Department of Conservation and Environment, *Development of Forest Management Systems for the Value Adding Utilisation Trial, East Gippsland: 1990-1991 Pilot Trial* , Melbourne 1993 p 33.
[281] DNRE Review of Sustainable Sawlog Yield East Gippsland Forest Management Area op. cit. p. 23
[282] ibid. p. 15
[283] CNR Proposed Forest Management Plan op. cit. p. 39
[284] ibid.

The Forest Management Plan directs that: "The Department will continue to actively research and develop new markets for the sale of residual logs."[285]

Given the past logging practices and the short term limitations on resources due to regrowth being unavailable, meeting the licence volumes is going to cost the Department more and more each year. This will happen as more low sawlog-productive sites need to be scheduled to make up the required sawlog volume. Figure 7.2 illustrates:

Figure 7.2 Site Scheduling Over Time

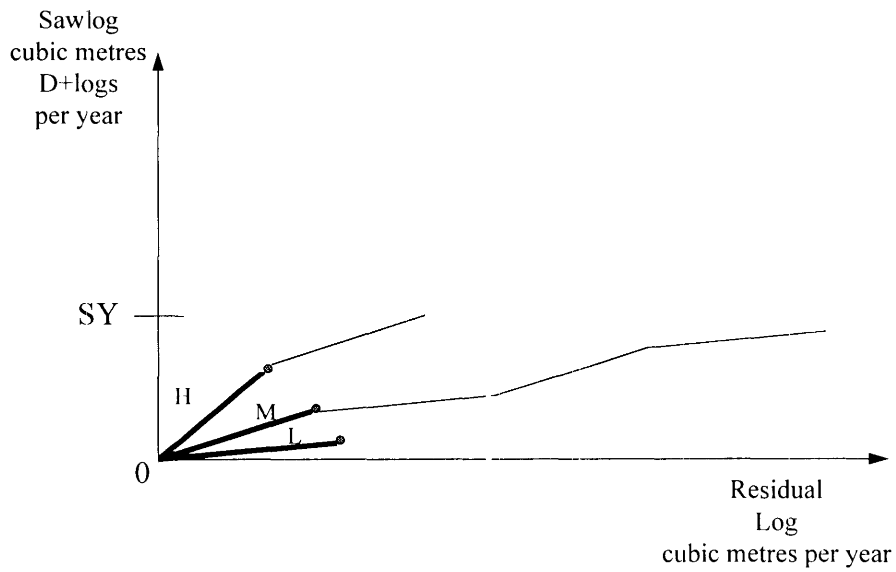

Figure 7.2 shows vectors which illustrate the minimum cost point of producing the fixed proportions of sawlogs and residual logs as per the log grading system. Each vector represents the cost of harvesting one hectare of forest and each hectare costs the same to harvest. The end point of each vector is equivalent to point "b" in Figure 7.1 showing fixed

[285] ibid.

proportions of sawlog and residual log according to the log grading system. The three vectors (H, M, L) represent sites having high, medium and low sawlog productivity respectively.[286] Productivity measures for the mature/overmature forest sites available for logging in East Gippsland are classified in terms of cubic metres of D+ sawlogs per hectare. High yielding forests are classified as having greater than 50 m^3/ha, medium yielding forests have between 15 and 50 m^3/ha while low yielding forests have less than 15 m^3/ha.[287]

The SY point on the vertical axis represents the maximum volume of annual sawlog harvest allowed and consequently the minimum supply commitments due to sawlog licences. The decision of which sites to schedule for harvest has been influenced in the past by demand conditions, leaving very few of sites like H for current harvest. To meet the SY supply commitment, it would be least costly to choose sites H and M since each site represents one hectare and therefore the cost of harvesting one hectare. For example, SY could be met in Figure 7.2 by harvesting two hectares: one site H and one site M. To meet SY using sites M and L, it would take four hectares and double the cost. The East Gippsland Statement of Resources, Uses and Values supports this: "If the current practice of biasing harvesting in the high volume stands continues, then the average area harvested annually will increase gradually throughout the period, reflecting the need to harvest larger areas of low yielding forest to meet the sustainable yield."[288]

Harvesting a larger area of forest in lower sawlog productive forests may result in more total cubic metres of timber if residual log is included. The total revenue collected will most likely be the same or less given that lower quality logs attract much lower prices than higher quality sawlogs. The gap between revenue and costs therefore narrows as harvest scheduling is forced into the lower sawlog productive forests.

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[286] Based on data collected in DCE Development of Forest Management Systems for the Value Adding Utilisation Trial, East Gippsland: 1990-1991 Pilot Trial p. 14.
[287] East Gippsland Comprehensive Regional Assessment - Resource and Economics Report, Commonwealth of Australia, 1996 Map 2 Current available sawlog resources (excluding regrowth forest).
[288] Department of Conservation and Natural Resources, *East Gippsland FMA - Statement of Resources, Uses and Values* op. cit. p. 135.

Given the institutional setting, the only way to remedy this in the short term is to attempt to increase the value given to residual log in consumption relative to sawlogs. The Department is following the forest management plan guidelines and is currently attempting to attract investment in domestic fibreboard processing plants to increase demand for residual log. This is proposed to solve the problem of the increasing volume of residual log which is incidental to the minimum sawlog production. The Department has already issued residual log licences to four operators for the combined harvest of 650 000 m^3 to be used for woodchips and other processing.

No Buyers for Residual Log

Residual log is able to be used for a range of processing including woodchips for export. The difficulty arises when the value of residual log in such processing is not high enough to justify the transport costs of either the raw product to a processing plant outside the region or the finished product from the region to key markets. Several domestic plants local to East Gippsland to produce pulp, MDF, woodchips have been rejected on these grounds in the past. In addition, sales of residual log to intrastate processing plants have been rejected in the past due to high transport costs.

Purchase of large volumes of residual log to produce export woodchips was previously restricted by the volume quota on export woodchips imposed by the Commonwealth Government. The quota caused harvest scheduling problems in East Gippsland which were becoming impossible to solve. If a residual log restriction was placed on Figure 7.2 on the horizontal axis in addition to the sustainable yield restriction (SY) and the log grading requirements, the licensed volume of sawlogs would not have been met because the residual log necessary to harvest the sawlogs could not legally be sold to woodchip companies. Part of the Regional Forest Agreement was that this quota be lifted from any Region covered by a RFA. Despite the woodchip quota being lifted from timber sourced from East Gippsland, there is still a question as to the viability of processors transporting the residual log to existing woodchip plants at Eden or Geelong.

In summary, the State needs to source sawlogs from low productivity forests to meet sawlog licence commitments due to past utilisation. It is only possible to meet sawlog commitments if a large volume of residual log is also harvested and is only economically viable if some revenue can be obtained for the residual log. Residual log is difficult to sell because of its low value in production and high transport costs associated with East Gippsland's location.

Separation of Management and Utilisation

Under the current regulatory and strategic framework, the management and utilisation functions are distinctly separated. Decisions have been made at the strategic level about the mix of timber products which is desirable for the forests of East Gippsland to produce. From this point, forest management is geared towards growing the maximum amount of sawlogs possible, regardless of what the market demands. Those responsible for utilisation then need to find buyers for the mix products which have been produced. This whole process is complicated by the very long time lines involved in forestry.

It is impossible to predict the demand for timber products 50 or 100 years into the future. If market conditions change during the growing phase of a stand, the only feedback mechanism currently available is to change legislation and policy. There is no flexibility in supply to meet changing demand in response to changing prices. The current shortage of regrowth forest even rules out the possibility of using short term site rescheduling to meet changing demand.

ECONOMIC SOLUTION FOR INTEGRATED HARVESTING

Marginal Forest Site

If all forest sites in the forest management area exhibited the same productivity characteristics, the optimal product mix (or even log grading) could be prescribed for all sites. The native forests of East Gippsland are large and diverse, covering a wide range of soil types, rainfall and elevation. The productivity of different sites with regard to timber varies widely across the East Gippsland FMA. Although the economic theory recommends integrated sawlog and residual log harvesting in most instances, it does not also conclude that all forest sites should be harvested. Given the differing productivities of forest sites, it makes economic sense to only harvest an additional hectare of forest if the revenue received from the harvest at least covers the cost of doing so.

The actual marginal cost of sawlogs depends on the level of residual log output because of the jointness in production as explained in Chapter 6. Due to the differing possible combinations of sawlog and residual log at each forest site, the marginal cost of sawlog production is likely to be different for each forest coupe. Setting a single price structure for sawlogs across the whole forest management area raises doubts as to whether this price will cover the marginal cost of production in all cases. Figure 7.3 makes use of the marginal cost curve for sawlogs derived in Chapter 6.

Figure 7.3 Marginal Forest Site

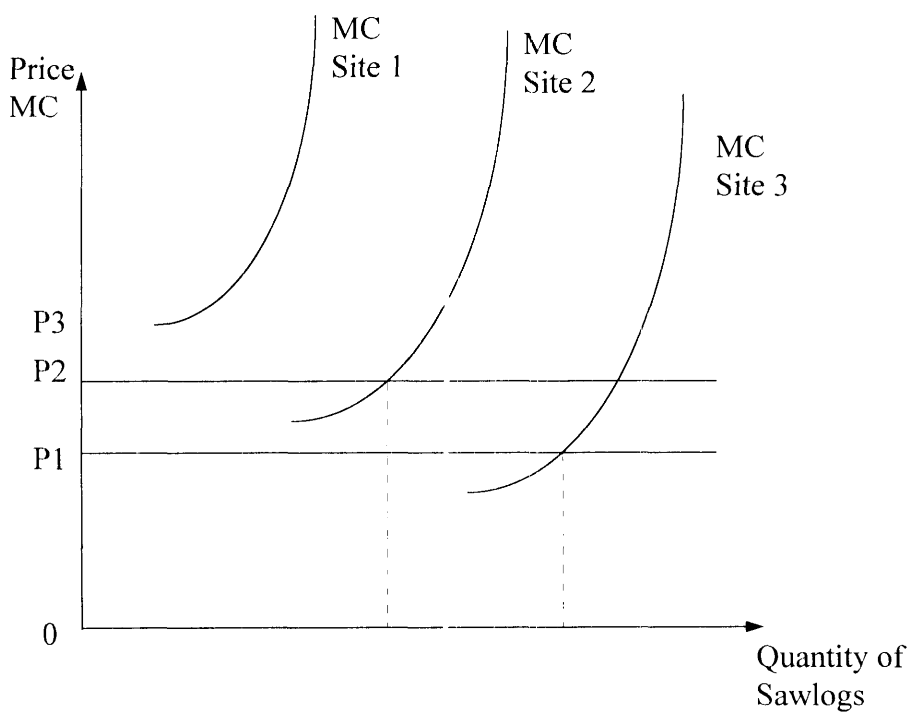

Figure 7.3 shows a number of marginal cost curves, each representing various levels of sawlog productivity. The marginal cost curves include logging the maximum amount of sawlog possible and any incidental residual log which is consistent with the sawlog-driven concept of the State of Victoria. The marginal cost curves are very steep indicating that it is almost impossible to increase sawlog production without changing residual log production. The position of the curves therefore represent the natural sawlog productivity of the site.

With sawlog royalties set at P1, it can be seen that the marginal cost of logging Site 3 will be covered even if no revenue is received for the incidental residual log harvested. Sites 1 and 2 will not be economically viable to log for sawlog only and will probably be left unharvested.

Setting the price of sawlogs regardless of the productivity of the forest site leaves the economic viability of the site entirely to how much revenue can be obtained for the residual log. For example, at a combined price of P2 in Figure 7.3 where P1 is obtained for sawlogs and P2 - P1 is obtained for residual log, sites 2 and 3 would become viable, but not site 1. In order for site 1 to be viable, P3 - P1 would need to be obtained for the residual log because the sawlog price is fixed at P1. This explains why the Department of Natural Resources and Environment is trying to find new markets for the residual log so that the price can be bid up and more forest sites will become viable. It is important that these sites do become viable because their sawlog volume has been counted in the commitment of sawlog volume to the sawmilling industry. Given the shortage of high sawlog productive sites, there will be pressure over time to log some sites which are not viable just to meet the sawlog commitments. There is evidence of this pressure in current harvesting operations where a coupe yielding 15 m^3/ha of D+ logs or more is able to be logged.[289] This is quite different to the amount agreed to in 1990:
"Following the implementation of the East Gippsland Agreement in 1990, it was agreed with industry that, based on the economics of harvesting, only coupes with a minimum average yield of 40 m^3(net) per ha of total product [D+ sawlogs] would be harvested. The

[289] Commonwealth and Victorian Regional Forest Agreement (RFA) Steering Committee Towards the Regional Forest Agreement, A paper to assist public consultation, October 1996, p. 22.

agreement was made on the understanding that, in addition to sawlogs, residual logs would be taken from all coupes."[290]

Sawlog Driven or Woodchip Driven?

The current promise of 650 000 m^3 of residual log per year which will result from the 250 000 m^3 of D+ sawlog depends on all sites being logged regardless of their viability. For this promise to be viable, the price of residual log will need to be quite high. If 40 m^3/ha of D+ sawlog is regarded as viable for sawlog only harvesting, then the incidental amount of residual log yield from truly sawlog driven harvesting will amount to a total of 5 090 241 m^3 of residual log which will last 7.83 years at a commitment of 650 000 m^3 per year. This indicates that many sites considered unviable for sawlog only will need to be logged in order to supply the promised amount of residual log. The alternative is to lower what is regarded as viable for sawlog only harvesting.

This information is taken from the 1993 Hardwood Timber Resources in the East Gippsland Forest Management Area and counts only forest stands with a utilisation category of "HIGH". This category refers to standing volume which carries above 40 m^3/ha of C+ net sawlogs. The difference in categories would mean that some sites considered to have "LOW" yields would actually carry above 40 m^3/ha of D+ sawlogs. Therefore the calculations above would be understated, with more total incidental residual log which would last longer than 7 years.

Despite the possible inaccuracy of the calculation, the fact remains that guaranteeing volumes of any quality timber places pressure on the forest resource if the viability of harvesting has not been considered.

It may be concluded that the sawlog supply commitment of 250 000 m^3 of D+ sawlog per year is inadvertently forcing harvesting to be driven by the need to harvest residual log. This is because large volumes of residual log will be harvested from coupes which contain

[290] Department of Conservation and Natural Resources, *East Gippsland FMA - Statement of Resources, Uses and Values* op. cit. p. 139

very few sawlogs and which, under normal circumstances, would not be regarded as viable for sawlog only harvesting. Such a view adds weight to the argument that harvesting is 'woodchip driven' but suggests that it is the current institutional arrangements which are creating this pressure, not woodchip companies. The sawlog-driven concept has therefore created the very problem for which it was designed to prevent.

The solution to the many problems caused by fixed sawlog volumes and prices would be to allow the market to determine both sawlog and residual log prices via a tendering system. This would ease the pressure on residual logs to fill the gap between forest sites which are viable and those which are not. The long term solution would also mean that harvesting would only be woodchip driven if woodchips commanded a high enough value in production. Such an outcome is possible, as illustrated by the Tasmanian experience: "There is considerable evidence to suggest that inefficiencies result from the present log allocation policies. It is claimed that under the log allocation system used in Tasmania, logs are being allocated to sawlog markets when their highest value use is in the pulplog market."[291]

Of course, at any point in time, the market prices of sawlogs and residual logs will determine which sites are viable and which are not. The point is that the fixing of sawlog prices for any period of time rules out the possibility of adjusting the scheduling of forest sites to meet market conditions.

The only justification for logging a forest site with low productivity might be to realise the potential of future yield. This point is argued by the Department of Conservation and Environment: "[W]hile the current standing sawlog volume is low, such sites as evidenced by their top height, have the potential to yield a far higher volume of sawlogs in the future. Harvesting and regenerating them now is seen as the only practical way to realise that higher sawlog yield."[292] This behaviour would only be economically viable if the future

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[291] DASETT Report of the Commission of Incuiry into the Lemonthyme and Southern Forests, Australian Tax Research Foundation, AGPS, Canberra, 1988 in ABARE *Forestry and conservation: an examination of policy alternatives* Project 9244.103, Commonwealth of Australia 1990 p. 25

[292] Department of Conservation and Environment, *Development of Forest Management Systems for the Value Adding Utilisation Trial, East Gippsland: 1990-1991 Pilot Trial* op. cit. p 63

revenue at least offset all future costs including the opportunity cost over that time of the loss incurred now on harvesting an uneconomic stand.

The issue surrounding sawlog or woodchip driven resource use exposes the link between forest management and utilisation. True flexibility where the resource may be used in accordance with demand driven prices, would require consideration of these prices at the management level. The theory and application completed in Chapters 4 and 5 includes price as a significant factor in determining the optimal forest rotation. Price was particularly important in Chapter 5 where sawlog and residual log harvesting were integrated when determining the optimal rotation.

Long Term Residual Log Supply

The current proposals to utilise residual log by developing a Medium Density Fibreboard (MDF) plant is a relatively short term solution. A significant area of regrowth forest will begin to impact on timber supplies around 2030 when the sawlog content of the forest will increase dramatically and residual log volume will decrease. Unless the grading system, log pricing and volumes can be relaxed, there will not be enough residual log to support such an industry over the longer term. This was identified some time ago in the DCNR's Statement of Resources Uses and Values which informed the Forest Management Plan and much of the Regional Forest Agreement:

"[T]he forecast yield of lower graded logs which would be produced in association with the harvesting of C+ sawlogs. This indicates a current availability of 740 000 m^3/year of D-logs, falling to 231 000 m^3/year between 2032 and 2061, thereafter rising to about 500 000 m^3/year. The expected drop relates largely to the lower proportion of low grade logs made available from harvesting regrowth forests compared with mature forests. Harvesting operations in regrowth forests above the minimum rotation age generally yield equal volumes of C+ and D- log, whereas mature/overmature forests generally yield C+ to D- log in the ratio 1:4.5. This prediction obviously has implications for long-term supply commitments to any industry that would utilise low grade logs, although it does not take into account the potential to manipulate log output ratios by undertaking silvicultural operations."[293] It should be pointed out once again that this information is stated in terms of C+ sawlogs rather than D+. If translated to D+, the effects would be even more extreme.

Regional Forest Agreement

One of the main outcomes from the twenty year agreement between the Victorian State Government and the Commonwealth Government is that the quota on export woodchips is lifted. If the quota was restricting purchases of residual log, the RFA will ease the pressure on harvest scheduling and the associated excess residual log. However, it should be realised that this was only a problem because of the fixed sawlog commitment. While the Regional Forest Agreement fixes one apparent problem, it actually adds to the overall inefficiency of the operation by disguising the problems associated with the sawlog-driven concept.

CONCLUSION

The institutional arrangements currently in place seem to be the cause of many of the problems regarding forest resource use for timber production in East Gippsland. Economic theory has helped to expose those problems and has been used to offer some solutions. These solutions will be translated to policy options in Chapter 8.

[293] Department of Conservation and Natural Resources, *East Gippsland FMA - Statement of Resources, Uses and Values* op. cit. p 135