An Analysis Process Used to Stratify Timberland Management Compartments Within An Ownership Based on Long-Term Earning Potential

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Abstract: As part of an ongoing effort to increase efficiencies in all aspects of forestland ownership and management, an analysis was conducted as the first segment of a larger project to stratify the forestlands managed by Temple-Inland Forest Products Corporation into three distinct categories: Non-Contributory, Investment Grade and Higher and Better Use. The criteria of site productivity, land use classification and the percentage of productive acres within a compartment were incorporated into a model to define those lands that do not effectively maintain a sufficient economic earning potential, and can therefore be considered as non-contributory. A compartment is a collection of timber stands that are geographically arranged in such a manner as to constitute a logical management unit. Land expectation values (LEVs) representative of the type of management activities appropriate for each type of site were applied as the base earnings potential for each stand within a compartment. Compartments with a computed return below a requisite earnings threshold will be considered non-contributory from a timber growth perspective. These compartments will be prioritized for further examination by forest managers to verify data accuracy, evaluate alternative management options, and to incorporate factors not conducive to inclusion in an LEV-based analysis.

INTRODUCTION

Temple-Inland Inc. owns or has management rights to 2.1 million acres of forestland in four states: Texas, Louisiana, Georgia and Alabama. The acquisition history of this land dates back to 1893, when T.L.L. Temple purchased 7,000 acres of timberland in east Texas to supply a sawmill that he would build the following year (Baxter 2002). Landholdings steadily increased over the next 110 years to the present levels. The reason for acquiring more land was generally to support periodic increases in conversion capacity, whether that meant the building of a new sawmill, or the acquisition of a paper producing company. Most recently, a small amount of land has been sold.

Regardless of the advent of modern, intensive plantation management, industrial forestry has historically been an extensive affair. Although the productive capacity of an individual piece of ground to grow crop trees has and always will be an important factor in its acquisition decision, other factors have tended to be equally, if not more, important. These factors can generally be defined as availability, scale, and that old real estate adage – location, location, location. First, availability dictates what you can and can’t buy, depending on how much you are willing to pay. Second, large-scale acquisitions invariably contain underperforming sub-elements, or parcels. The buyer may like the high quality land and timber comprising ninety percent of the offering, but must take the less desirable ten percent to get it, as the seller may not offer to exclude the lower quality portion from the purchase. As for location, that’s obvious: a tract of land with only moderate productivity may still be a good buy if it is only a few miles from a mill, or contains an existing road network providing good access.

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So over time a large landbase develops that, in its entirety, fulfills the mission of providing a requisite portion of the sustainable supply of fiber to a set of converting mills. And historically, the extent of the purpose of owning forestland was one of insurance of supply, to provide a significant portion of the internal fiber demand to guarantee continuous supply in the face of any possible market disruptions. Perspectives have changed over time. Shareholders expect a reasonable return on investment from all elements of a corporation; insurance against supply disruptions is not sufficient. It can also be argued that southern fiber markets are now robust enough that significant supply disruptions are not very likely, as long as it is recognized that a short-term price premium may be unavoidable.

As the measure of effectiveness for a landbase has changed over time to one of generating an acceptable return on investment, it is invariably the case that within a landbase are individual tracts that, measured by themselves, cannot provide a sufficient economic return from the act of sustainable timber management. To ensure that the total forest asset is providing an acceptable economic return to the firm, as is required of all other assets of the firm, it is therefore necessary to periodically assess the performance potential of each individual portion of the forest.

**OBJECTIVE**

The goal of this project was to develop a quantitative process by which to assess all land holdings in Temple-Inland Forest for their applicability of providing an acceptable economic return from management for fiber production. Those lands identified as not currently generating an acceptable return are being further reviewed in more detail to confirm the initial assessment, or recognize the contributions the lands make to other objectives. Pending confirmation of the initial assessment, these lands will be identified as non-contributory, and appropriate action will be taken to either dispose of them in an optimal manner, or perhaps alter the manner in which they are currently managed in an attempt to increase their earnings potential to an acceptable level. Only forestland owned by Temple-Inland was included in the analysis; land that is leased by Temple-Inland for the purpose of fiber production was not included, as this analysis focused on the long term perspective of evaluating the economic characteristics of land management.

Although the criteria of measurement for determining whether a tract of land is non-contributory is its estimated economic return from the production of pulpwood and sawtimber, it is not the intent of this analysis to isolate, or recommend for disposal those lands currently designated for management for purposes other than fiber production. Lands having such alternative management goals may include streamside management zones, endangered or threatened species habitat, distinctive sites, etc. However it is worthwhile to identify and recognize the potential economic burden placed upon the firm by such management. This recognition should help to increase awareness of the economic cost of these management objectives, which should help with future decisions regarding management objective assignments.

It is also widely recognized that Temple-Inland owns lands that have an open market value significantly greater than what can be achieved from management for fiber. These lands will also be identified, and an appropriate strategy developed to take advantage of that value. The process for identifying these acres is different than that used to identify non-contributory acres, and is not addressed here.
METHODOLOGY & MODEL DESCRIPTION

There are three phases to this project:

**Phase I** Those tracts in the Forest that appear to have an unacceptable earnings potential were identified. A model was developed that provides the approach for evaluating the earnings potential for tracts assuming they are to be managed for timber production. The **three main drivers in this model are 1) Current land use classification, 2) Site Quality, and 3) The percentage of productive acres within a compartment.** Additionally, tracts are analyzed based on their proximity to other tracts. This proximity screening will help to identify access issues should it be decided to dispose of the tract. It is recognized that this process will be repeated periodically as management methods and fiscal expectations change over time.

**Phase II** Each tract on this list was then reviewed by the respective management forester to determine whether disposal is the appropriate action to take. This involved verification of current stand conditions and projected harvest timings, assessment of market conditions, proximity to adjacent landowners for trade purposes, etc.

**Phase III** The third phase concerns the identification of tracts that have a market value significantly greater than what can be achieved from the production of timber. The identification criteria and methods are fundamentally different than those included in Phase I, yet the earning potential of each tract does serve as a baseline to which the market value is to be compared to determine if the tract is of a higher value. The process of higher value determination is not addressed here.

DATA

This model focuses on the **compartment** as the unit of measure for economic productivity. Temple-Inland Forest defines a compartment to be a collection of one or more homogeneously-managed tracts called **stands**. While the stand is a unique entity, and has a complete data description, the compartment was the better choice for determining productivity. There are two primary reasons for this: first, streamside management zones (SMZs) are considered separate stands. Yet due to their spatial distribution within any portion of a landbase, it is often inherently impossible to separate an SMZ from the adjoining stands for purposes of ownership change considerations. Secondly, stands are continuing to decrease in size as a result of harvest layout procedures suggested by the Sustainable Forestry Initiative (SFI) (AF&PA 2002). Yet these smaller stands within a compartment often have very similar characteristics, as they were separated from former larger stands more for size reasons rather than homogeneity of growth potential characteristics. For ownership considerations, these stands should be treated as a group. Therefore, the compartment becomes the logical unit of performance measurement, and the challenge is to integrate the estimated performance potential of the individual stands within a compartment, including SMZs, to a single measure representing the entire compartment. There are approximately 3,400 compartments in Temple-Inland’s Western Forest, containing approximately 17,000 stands. In Temple-Inland’s Eastern Forest, 628 compartments contain approximately 2,500 stands. Figure 1 portrays a grouping of three adjacent compartments, along with each compartment’s stands.
Figure 1. Three adjacent compartments, along with their stand boundaries.

Land Classification & Site Quality

Temple-Inland has developed a land classification system that categorizes the landbase into strata based upon each stand’s establishment history and the current management practices utilized on the stand to achieve its stated objectives. Certainly the management objectives for any particular stand are not permanent. Temple-Inland can, and does alter individual stand objectives periodically to better conform to corporate policy, business objectives and environmental considerations. It is worth repeating that this analysis evaluated stands and compartments based on their current usage classification. Some of these management classifications are: pine plantation utilizing a clearcut final harvest; naturally-established pine stand with single-tree selection harvest; naturally-established hardwood stand with single-tree selection harvest; aesthetic management zone; streamside management zone; etc.

Earnings potential was measured by the internal rate of return (IRR) of the stand. IRR was determined differently for each stand classification type. For pine plantations the present net worth (PNW) of an infinite series of optimal rotations was calculated. The quality of the site is represented by its measured loblolly (Pinus taeda) or slash pine (Pinus elliottii) site index, base age 25. Site index was rounded to the nearest ten feet, and plantation IRR values were calculated for each ten foot increment within the range of existing site indices.

Management Assumptions

In order to determine approximate returns for plantations of various site indices, some general assumptions related to the management activities for the different site classes were made,
with the knowledge that in reality our forest management is site specific. A regime was modeled reflecting the typical site preparation methods, nutrition enhancements, competition control measures and stocking management methods currently employed by Temple-Inland. Current cost figures for these treatments were applied. Applicable ad valorem tax rates for the county in which each particular plantation is located, along with a generalized management overhead cost were also included. Revenues represented by harvested pine products and hunting leases were modeled. For naturally-established pine and hardwood stand types the present net worth of repetitive selection harvests using typical yields and management considerations was calculated.

For pine plantations, it was assumed that the stand was in a bare ground condition, hence the usage of a Land Expectation Value (LEV) measure that analyzes an infinite series of rotations given a starting point of bare ground. The net present value (NPV) method of stand valuation incorporates the discounted value of the existing rotation as well as the value of the ground for an infinite series of rotations. Utilizing the NPV method results in values equal to the LEV if the tract is in a bare dirt state, up to values approaching several thousand dollars if there currently exists a mature stand of high value products. The reason in this analysis for not measuring the value of the existing rotation is that tracts containing young stands would categorically receive substantially less value than tracts with mature timber, almost regardless of any other condition of the site. Therefore, for the purpose of identifying acres that do not contribute an acceptable return, the resulting set of identified tracts would have been comprised mainly of young stands. This bias is fundamentally flawed, as it defies all common definitions of sustainable forest management. It does not permit the determination of long term earning potential. To prevent the dominance of such a short term bias all current stocking conditions were ignored in the analysis. Once a compartment is identified as non-contributory, the current stocking conditions may then have a bearing on the timing of disposition, or change of management objective.

**Productive Acres**

*Total Stand Acres* can be defined simply as the total acreage within the stand. This is the figure used for all computations related to the cost of ownership, such as depletion and ad-valorem county property taxes. *Net Stand Acres* refers to those acres within a stand that are actually managed for fiber production. Net stand acres do not include right-of-way easements, ponds, woods roads, or other such acreages that are not manageable for the purpose of growing trees. The proportion of net stand acres to total stand acres is applied against the stand’s inherent productivity rating. The implication of this is that compartments with a lower aggregate ratio of net to total acres in their stands will have a lower earning potential, all other criteria being equal.
Model Structure

The following algorithm describes the methodology used to arrive at a single value representing compartment earning potential. This algorithm is portrayed in Figure 2.

1. For each stand, any acres within the stand designated as Special Use were subtracted from the stand’s Net Acres. This figure is the stand’s Productive Acres.
2. If the stand is a pine plantation, the Site Class value is assigned the site index (base age 25) value rounded to the nearest 10 feet.
3. An IRR value, or Stand Earning Potential, is assigned to each stand based on its current management objective. For pine plantations, this value is commensurate with the Site Class.
4. For pine plantations, the effect of annual county property tax payments represents an approximate burden of -0.14% IRR for each $1 per acre paid. Therefore, 0.14% is subtracted from the stand’s IRR for each $1 of county taxes, net of any hunting lease revenue per acre for tracts in that county. The -0.14% burden was assumed to be consistent across all stand types.
5. For each stand, Productive Acres is multiplied against the net IRR value, to get a Weighted Productive Acre value.
6. Weighted Productive Acres are then summed together for each stand within a compartment, and this result is divided by the sum of the compartment Total Acres to derive the expected earning potential of all acres within the compartment.

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CEP = \frac{\sum (SEP \times SPA)}{\text{compartment total acres}}
\]

where:
- \(CEP\) = compartment earning potential
- \(SEP\) = stand earning potential
- \(SPA\) = stand productive acres = stand net acres – special use acres

**Figure 2.** Basic algorithm to calculate compartment earning potential.

Temple-Inland forestland is organized into two distinct regions – East Texas/West Louisiana and Northwest Georgia/Northeast Alabama. One differentiating characteristic between the two regions is that the forestland in the West tends to be grouped into larger blocks of contiguous compartments compared to the forestland in the East, which tends to be grouped into smaller blocks of contiguous compartments. Any given compartment in the West is more likely to be immediately adjacent to one or more other compartments relative to any given compartment in the East. For a compartment whose computed earning potential is below a requisite threshold, whether or not that compartment is contiguous to another compartment can have a significant impact on the decision to dispose of or retain the compartment. In general, a compartment that is immediately adjacent to another compartment is more difficult to
recommend for disposition; this is particularly true for a compartment that is completely embedded within a set of surrounding compartments.

Therefore in the analysis of compartments in East Texas/West Louisiana a geographic information system (GIS) was used to define the adjacency status of each compartment as: adjacent to one or more other compartments; within 500 feet of, but not immediately adjacent to another compartment; or at least 500 feet away from the nearest compartment. This characteristic was not included in the algorithm to determine earning potential, but was provided as an indicator of isolation to assist the management forester in assessing compartments prioritized in the analysis.

RESULTS & DISCUSSION

The product of the analysis was a listing of all compartments, ranked by calculated earning potential. It was then incumbent upon the different management foresters to review those compartments ranked at the lower end of the scale. An automated spreadsheet tool was developed to query this list and assist the forester in his/her review of those compartments by populating a worksheet with all data representing the factors included in the formulation of the earning potential estimate for each stand within the compartment chosen for review, along with a collection of other data elements related to the compartment’s stands that might assist the forester in their review and disposition/retention decision.

In some cases, the numbers by themselves were interesting, but were mostly in-line with expectations. However, two welcome surprises are coming out of the results review process. While Temple-Inland Forest prides itself on the quality and consistency of its forest data, it is nevertheless impossible to have a data system comprised of some 19,500 stands that is without errors. While some errors are obvious, others are subtle, and can be difficult to detect. When a particular compartment is identified as being an economic under-performer, its data becomes closely scrutinized. This review quite often reveals data errors that would otherwise have gone unnoticed. Regardless of the impact of the error on the result of the calculated economic performance, the system is improved each time an error is identified and corrected.

A second unforeseen benefit resulting from the review process is the new light, or sense of urgency placed on compartment organization. Two or more adjacent compartments may all have marginally acceptable ratings. However, there may be two or more adjacent stands, each belonging to a different compartment, and each with a poor earning potential, that could be grouped together into one block and disposed of, or otherwise be managed differently to better achieve economic objectives.
CONCLUSION
In an effort to assess and improve the economic efficiency of the forestland of Temple-Inland, an analysis process was developed to estimate the earning potential of every compartment of land. The algorithm to estimate earning potential was based on stated management objectives of the land, the inherent productivity of the land, and the proportion of each compartment that is actually capable of growing commercially-viable trees. Once earning potential ratings were developed, those compartments having unacceptable ratings were closely scrutinized by their respective management forester for data accuracy, suitability for alternative management, or for disposition. The importance of this hands-on review process cannot be overemphasized. It is here that both the most data errors are found, as well as the greatest creativity for optimizing the economic potential of each compartment. It must be emphasized that this is one tool that has helped to evaluate a very large and complex asset. It is by no means expected to be the definitive tool; other processes have and will continue to be employed to routinely assess the performance of the company’s forestland. Finally, this exercise should be periodically repeated. Management objectives and the criteria for success change over time; database errors do have an impact, and are always present and recurring.

LITERATURE CITED