COMPARATIVE INDUSTRIAL FORESTRY ECONOMICS:
S.E. UNITED STATES AND BRAZIL

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ABSTRACT

Even though economic comparisons of industrial forestry in the Southeast United States and Brazil are often made at a macroeconomic level, additional insights can be gained by examining managerial and production economics at the more specific level. Besides having a favorable climate for tree growth, much of the success of Brazilian forest industry has been due to managerial factors. Specifically, Brazilian forest industry has focused on developing and knowing their production possibilities curve for producing wood fiber and have been clear about their strategic values. Brazil is shown to be a low cost producer of pine and hardwood pulpwood when stumpage cost is calculated using the cost-price method at an 8% rate of return. However, market stumpage prices in the Southeastern United States continue to be competitive. With the rapid rates of change in the worldwide demand and supply for land and fiber, industrial forest managers in both countries have lessons to learn from each other.

INTRODUCTION

I appreciate the opportunity to speak to you today. I am reminded of a couple of statements about economists by economists. The first is that if all economists were eliminated there would be an increase in the GNP. The second is that success in economics is essentially based on the ability to tell a good story. I hope the first statement is untrue, and I fearfully believe that the second statement is true. "Fearfully" because I think I am more adept at crunching numbers than telling stories. I therefore consider it a challenge to both tell you a good story and leave you with a message that might increase the GNP in some small measure!

Because this subject is "close to my heart" both professionally and personally, I need to preface my remarks by sharing the relevant biases and perspectives alluded to in my biographical introduction. My past forestry experience in Brazil and my current work in the Southeastern United States is as an industrial forest economist and planner. Therefore,
I have a decidedly "micro-" economic perspective. Comparative economics between regions is often approached using an aggregate, macroeconomic perspective. The approach I take here assumes that the key to comparing industrial forest economics at the aggregate level is an examination of resource use at the local level. It is here that landowners and managers are making and revising their resource allocation decisions which in the aggregate have macroeconomic consequences.

Figure 1 illustrates the cycle of events which takes place in the spatial and temporal allocation of resources. Information is the basis we use to both form our values and make decisions. Decisions lead to actions which have their own consequences. These consequences provide additional information for revising our values and decisions. This behavioral cycle reminds us that economics is essentially a social science regardless of how quantitative it may appear. As economists we analyze the "value" component using utility functions at the microeconomic level or welfare functions at the macroeconomic level. Likewise, we use production possibilities curves to characterize the linkage between resource allocation actions and consequences. Both these concepts are illustrated in Figure 2 for a society which gains welfare by using its land base to produce either wood product or other land-based goods and services. Point A represents the highest level of welfare (W1) that this society can achieve in the absence of trade or new production possibilities. In this society the relative price between wood and other land-based outputs (Po/Pw) is determined by the "invisible hand" of the free market.

In the real world, society is likely worse-off than Point A due to inefficiencies or constraints which result in resource allocation somewhere else along or on the interior of the production possibilities curve. Nevertheless, the power of the economic paradigm shown in Figure 2 is that it is equally applicable at the macroeconomic, microeconomic, or household levels. Whether the audience be a nation as a whole, an industry, a company, or even a teenager, the central normative message of economics is that welfare is improved primarily by changing the production possibilities curve or by changing values. The core of my message today is that forest industry in the Southeastern United States needs to do a better job of knowing and communicating its production possibilities and values. In addition, my thesis is that the success of Brazilian forest industry to this point is largely due to managerial reasons. Specifically, they have focused on developing and knowing their production possibilities curve for producing wood fiber and have been clear about their strategic values. Finally, I propose that forest industry in both countries have lessons to learn from each other as demand increases for land-based outputs due to larger and more affluent populations.
Figure 1 - Resource Allocation Cycle

Consequences

Information

Values

Spatial Resource Allocation

Temporal Resource Allocation

Decisions

Actions

Figure 2 - Production Possibilities and Welfare

Wood Product Output

Other Land-based Output

\[- \frac{P_o}{Pw}\]
Relative to the Southeastern United States (SE U.S.), Brazil has a relatively small share in the current and potential world wood supply, Figure 3. In 1993 Brazil’s wood supply from plantation forests was 23% that of the wood supply from the SE U.S. That proportion is expected to increase slightly by 2010. Nevertheless, fast-growing plantations have had a major impact on Brazil’s pulp and paper trade balance. In 1970 the export/import value ratio was 0.26, Figure 4. In 1990 that ratio had increased to 4.2 with the export value increasing from $6 million to $1201 million. This represents a 20% annual rate of export value growth over the period. What makes this record all the more impressive is that a substantial portion of pulp and paper production is consumed domestically, Figure 5. For example, in 1992 domestic consumption was 69% of pulp production and 74% of paper and board production.
Figure 4 - Pulp and Paper Trade Balance

U.S. $ millions

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<thead>
<tr>
<th>YEAR</th>
<th>Import Value</th>
<th>Export Value</th>
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<tr>
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<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1975</td>
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<td>400</td>
</tr>
<tr>
<td>1990</td>
<td>1300</td>
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</table>

Figure 5 - Pulp & Paper Production and Wastepaper Consumption, 1992

<table>
<thead>
<tr>
<th>Thousand tons</th>
<th>Paper and Board</th>
<th>Pulp</th>
<th>Waste Paper</th>
</tr>
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<tr>
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<td>5298</td>
<td>1471</td>
</tr>
<tr>
<td>Production</td>
<td>4915</td>
<td>5298</td>
<td>1471</td>
</tr>
<tr>
<td>Exports</td>
<td>1283</td>
<td>1666</td>
<td></td>
</tr>
<tr>
<td>Imports</td>
<td>262</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Consumption</td>
<td>262</td>
<td>75</td>
<td></td>
</tr>
</tbody>
</table>

From Seneca, 1993
In a 1983 book, *Comparative Economics of Plantation Forestry*, Sedjo divided the world into twelve plantation forest production regions:

Europe: 3. Scandinavia
Latin America: 4. Amazonia; 5. Central Brazil;
6. Southern Brazil; 7. Chile
Africa: 8. West Africa; 9. South Africa

Even though new players have emerged on the scene, notably China, this list is still useful for comparing the relative economics of plantation forestry within Brazil.

**Forest Productivity and Silviculture**

For these geographic regions there can be as much variation in productivity within a region as among regions. Nevertheless, firms within each region adapt to a similar set of factors which influence plantation production economics: climate, soils, land availability, and infrastructure.

Southern Brazil and Amazonia are at the extremes with respect to each of these factors. Amazonia is in the tropical region; Central Brazil is in the subtropics, and Southern Brazil is both in the subtropics and temperate regions. Potential biological productivity for a given plantation species is determined by the particular combinations of rainfall, solar radiation, and temperature. A large part of the productivity differences for loblolly pine between the SE U.S. and Southern Brazil can be explained by the more favorable climatic conditions in Southern Brazil. Likewise, many of the differences in productivity between regions in Brazil are as much due to climate as to soils. The soils of Amazonia vary more in fertility than what is often described in the popular press. With respect to forest productivity, many are not dissimilar to the forest soils of the SE United States.

With respect to infrastructure, economic development in Brazil followed a pattern similar to the United States. The more temperate regions of Brazil were industrialized prior to the more tropical ones. Plantation forestry in Southern Brazil has focused on production for domestic markets, while Central and Northern Brazil have produced export goods with less value-added. Eucalyptus plantations were initially
established for supplying foundry-grade charcoal for steel production. This continues to be a major use of eucalyptus in Central Brazil. In Southern Brazil several firms have pine plantation rotations which produce plylogs, sawlogs, and pulpwood for domestic consumption.

The greater level of industrialization in Southern Brazil has resulted in higher land costs and greater competition between agriculture and forestry for what are currently some of the most productive soils for wood production. The biggest question with respect to land for plantation development in both Central Brazil and Amazonia concerns not soil suitability or land cost but land availability. Wilderness and cattle ranching are the dominant competing uses. Based on both domestic and international public values and attitudes about tropical and subtropical rainforest ecosystems, the biggest potential for expansion of forest plantations may be on abandoned or undertilled pastureland.

Though climate, soils, and infrastructure are important; technical knowledge is of equal or greater importance for explaining productivity differences. Technical knowledge and the accompanying technology describe the ability and methods which firms use to adapt to their environments. The successes in all three production regions of Brazil are due to the willingness of Brazilian firms to first copy and secondly to invest in new technology for growing and harvesting tree crops. With respect to pine plantations much of this technology was initially brought from the SE U.S.. This was of considerable advantage to southern Brazil which in some respects has a similar climate. Central Brazil and Amazonia have been on a different learning curve since they have had to look elsewhere for silvicultural technology. However, all three regions in Brazil have been able to learn and adapt quickly due to relatively short plantation production cycles. This explains in part why the relative advantage that the SE U.S. may have had in pine plantation silviculture has diminished or disappeared, even though there is more research funding and infrastructure in the United States. The approximate differences in pine fiber productivity are shown in the upper part of Figure 6.

With respect to hardwood production, eucalyptus is the principal species. Central Brazil continues to have the technological advantage, having initially adapted technology from Africa and Australia. However, Southern Brazil and Amazonia are rapidly developing technologies adapted to their climates and soils. Due to an abundant hardwood resource suitable for pulping at a reasonable stumpage price, the SE U.S. has had no incentive to develop hardwood plantations on a large scale. The lower part of Figure 6 shows the relative
productivity of eucalyptus plantations in Brazil and coppice hardwood management in the S.E. United States. It remains to be seen whether hardwood plantation management in the Southeast will be economically competitive in the future.

**Figure 6 - Relative Fiber Productivity**

![Graph showing relative fiber productivity](image)

Delivered Fiber Cost Components

Subsequent sections describe the production economics which determine stumpage costs in Brazil. However, any discussion of comparative wood costs must also consider the other parts of delivered wood cost, namely: harvesting, transport, and infrastructure. This is particularly true given the great differences in labor, fuel, and infrastructure costs that exist between the countries. Estimates of the various components of delivered pulpwood costs for both pine and hardwood species are shown in Figure 7. The summary message from this graph is that on average Brazil is a low cost producer of delivered fiber to the mill gate. The numbers are gross averages and lack precision, but I believe them to be accurate enough to spend some time explaining why Brazilian producers might be able to deliver fiber to the mill gate for less cost.
With respect to harvesting, Brazilian producers have lower costs for the following reasons:

1. Cheaper labor costs for the same level of technical know-how and productivity;
2. Willingness and ability to modify technologies from the United States and Scandinavia in order to make them more suitable for their workforce and costs of capital;
3. Good operational planning and integration between land management and harvesting operations.

My general observation is that Brazilian producers have taken a more systematic and engineering approach to planning and conducting harvest operations. This is in part due to the fact that plantation development and an inventory of plantation grown wood preceded the planning and development of harvesting systems. In contrast, harvesting systems in the United States were developed for an existing natural forest and are now being adapted for current and future plantation forests. Brazil started with a new paradigm suitable for their situation while many United States producers continue to struggle with an older, inappropriate one in a new situation. In the future the challenge for Brazil’s producers will be how to keep costs low given increasing labor costs and small tree sizes.

It might be considered surprising that transport costs are generally lower in Brazil given the higher costs of diesel fuel. The explanation is that Brazilian firms have more concentrated land bases around production facilities and higher levels of fiber production per acre for those land bases. Both factors lead to lower average haul distances. Small tree sizes and increasing opportunity costs of land ownership are among the challenges facing Brazilian producers seeking to minimize hauling costs. United States producers have a good opportunity to lower haul costs by increasing the productivity of the land base, both from company-owned and private lands.

Relative overhead costs are more difficult to assess than the other sources. This is due in large part to differences in definitions both between and within countries as to what constitutes "overhead". Within Brazil there is a wide degree of variation in the degree of fringe benefits provided workers. Some companies have the equivalent of "company towns" which provide a variety of community services (housing, utilities, schools) at subsidized rates. It is unclear whether these overhead costs are included in the Jaako Poyry estimates in Figure 7 or whether they are a component of manufacturing costs. Regardless, pressures exist for Brazilian companies to either reduce the level of these subsidized services and/or increase labor productivity.
An interesting question facing some companies is to what extent the provision of company services enhances labor productivity for the current as well as the next generation of laborers. In Central Brazil and Amazonia this question is particularly relevant given the low level of available public services. This is the same question that American industry faced earlier in this century where company towns had been built to help provide a low cost, productive and stable work force.

Stumpage Cost Accounting

By now some of you have looked at the costs of hardwood and pine stumpage in Figure 7 and may be saying something like "Those numbers are too high." or "Those numbers are too low." Both statements could be correct depending upon the particular stumpage markets you are dealing with or the cost accounting method used for stumpage produced from your own landbase. For that reason, I will use two different concepts for estimating stumpage costs. The first is the "market clearing" price based on an average price over some geographic area at some point in time. This is the price we are most familiar with in the SE U.S. where relatively competitive markets exist for stumpage.

Figure 7 - Delivered Pulpwood Costs

![Diagram showing delivered pulpwood costs for hardwood and pine, with breakdown by region (SE U.S. and Brazil) and cost categories (stumpage, harvesting, transport, overhead). Total costs for hardwood are $29.55 and for pine are $29.50. The costs are broken down into subcategories with the highest being stumpage, followed by transportation and harvesting. Overhead is the least significant cost component.]
Stumpage markets are not as competitive in Brazil as in the United States since on about 80% of Brazilian firms' delivered wood comes from company produced stumpage. Therefore, the second concept I will use is that of a "cost-price" of stumpage. This is the cost that a producer would have to receive for stumpage in order to receive a competitive rate of return on both direct costs and land costs. This is calculated by dividing the future value of a stream of silvicultural costs by the fiber production associated with that management regime. Intermediate returns (e.g. hunting revenues, pinestraw receipts) are treated as negative costs. The calculations are straightforward for pulpwood management regimes with no thinnings. Calculations are more complex when a management regime includes intermediate thinnings or multiple products. In the case of thinnings an iterative process can be used to set a pulpwood price for the thinned wood which is equal to the final cost price of all pulpwood produced. For multiple products a market price for the other products (e.g. sawlogs) has to be estimated and treated as a negative cost prior to arriving at a cost-price for the pulpwood fiber.

**Hardwood Stumpage Costs**

Figure 8a shows the direct invested cost and the mean annual increment at the end of the rotation for representative eucalyptus management regimes in Sao Paulo State and Amazonia. The regime for the SE U.S. is for a natural hardwood area which has been clearcut and regenerated using coppice and natural regeneration. Notice that the rotation lengths for the eucalyptus regimes are between one-fourth and one-fifth that of the SE U.S. hardwood regimes. Also note that sustainable yields are four times higher. Even with the shorter rotations, the cumulative invested cost per acre is two to three times higher than in Brazil. Given the higher investment costs per acre it is clear why Brazilian producers invest a considerable amount of time and money on applied research to understand silvicultural regimes and yield responses.

From the viewpoint of agricultural production economics we are looking at a management regime more akin to a perennial agricultural crop than a forestry crop - a case where high per acre input levels can be rewarded with higher outputs in a relatively short period of time. Figure 8b compares the stumpage costs between these management regimes
as well as recent market prices for Georgia and Tennessee (TimberMart South). The costs without land are calculated directly from the values in Figure 8a. For example, the calculation for Amazonia is as follows:

\[ \frac{\$606/\text{acre}}{(12.1 \text{ tons/ac./yr} \times 5 \text{ yrs.})} = \$10.01 / \text{ton}. \]

To these direct costs I have added the land rent charge per ton of stumpage for the three regions assuming the following bareland values:
- Sao Paulo: \$625 / acre (Florestar Estatístico)
- Amazonia: \$400 / acre (my estimate)
- SE U.S.: \$200 / acre (my estimate)

If we exclude land costs, production costs of Brazilian hardwood stumpage are greater than either the SE U.S. coppice management regime or market prices. However, if we consider the opportunity cost of land, the Brazilian regimes have cheaper stumpage production costs. This is due to the relatively low productivity per acre and the long rotations in the SE U.S.. Producers can reduce the cost of land by one or more of the following means:
1. Increase productivity per acre;
2. Generate other land-based revenues at the same time (e.g. hunting, agroforestry);
3. Treat land as a separate asset with a capital appreciation investment return of its own;
4. Lower the required rate of return on land, based on its distinctive risk attributes relative to other capital assets.

It is not surprising to find firms in both countries pursuing one or more of these strategies. An obvious advantage of increasing productivity per acre is that it has the added benefit of reducing average haul costs. As native hardwood inventories in the SE U.S. are reduced or become unavailable due to competing land uses, U.S. firms will be faced with confronting the issues of economically sustainable production more directly.

**Pine Stumpage Costs**

Figure 9a shows the invested costs and yields for a pine pulpwood management regimes with no thinnings. The total invested costs are similar in all three regions. Rotation lengths in Southern Brazil and the SE U.S. are also similar; though both regions have the flexibility to have shorter rotations than those shown here. The shorter rotation of 12 years in Amazonia reflects the current practices of two firms in that region. There is flexibility in Amazonia for longer
Figure 8a - Hardwood Management
Invested Cost @8% and Productivity

- **Direct Costs**
- **Mean Ann. Increment**

<table>
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<tr>
<th>Region</th>
<th>Direct Costs</th>
<th>Mean Ann. Increment</th>
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<tbody>
<tr>
<td>Sao Paulo 7-year</td>
<td>$921</td>
<td>12.6</td>
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<tr>
<td>Amazonia 5-year</td>
<td>$606</td>
<td>12.1</td>
</tr>
<tr>
<td>S.E. U.S., Coppice</td>
<td>$283</td>
<td>3.0</td>
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Figure 8b - Hardwood Stumpage Costs

- **Direct Costs**
- **Land Cost**
- **Market Prices**

<table>
<thead>
<tr>
<th>Region</th>
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<tbody>
<tr>
<td>Sao Paulo</td>
<td>$15.66</td>
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<tr>
<td>Amazonia</td>
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<tr>
<td>SE U.S.</td>
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<tr>
<td>TMS: TN</td>
<td>$3.32</td>
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<tr>
<td>TMS: GA</td>
<td>$8.19</td>
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*Production Cost-Prices*

*Market Prices*
Figure 9a - Pine Pulpwood Management
Invested Cost @8% and Productivity

<table>
<thead>
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<th></th>
<th>Direct Costs</th>
<th>Mean Ann. Increment</th>
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<tr>
<td>SAO PAULO 20-year Rotation</td>
<td>$995</td>
<td>14.66</td>
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<tr>
<td>AMAZONIA 12-year Rotation</td>
<td>$908</td>
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<tr>
<td>SE U.S. SI-65 20-year Rotation</td>
<td>$954</td>
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Figure 9b - PINE PULPWOOD MANAGEMENT
STUMPAGE COSTS

<table>
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<th>Direct Costs</th>
<th>Land Cost</th>
<th>Market Prices</th>
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<tbody>
<tr>
<td>SAO PAULO</td>
<td>$12.09</td>
<td>$2.25/acre</td>
<td>$2.00/acre</td>
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<tr>
<td>AMAZONIA</td>
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<td>$2.00/acre</td>
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</table>
Figure 10a - Pine Multiple Product Mgt.
Invested Cost @8% and Productivity

- Direct Costs
- Mean Ann. Increment

Figure 10b - Pine Multiple Product Mgt.
Stumpage Costs

- Direct Costs
- Land Cost
- Market Prices

(Additional data and graph details)
rotations, particularly as more suitable genotypes are planted. The large differences which exist between regions is with respect to productivity; the Brazilian regions have between two and three times the productivity of that in the SE United States.

These higher levels of productivity result in a lower cost-price of stumpage in Brazil, Figure 9b. The difference is even greater if the opportunity cost of land is considered. The market price of Georgia stumpage is comparable to the cost price of Brazilian stumpage including land cost. As in the past, nonindustrial private landowners will play a critical role in determining the direction of future market prices in the Southeast U.S.. They have the opportunity to increase the productivity on their lands in response to the expectation of increased raw material prices in the future. Also, they have lower carrying costs for land due to the other benefits they generally derive from owning land.

Pine management regimes in Amazonia are exclusively for the production of pulpwood. In Southern Brazil, a few firms have regimes which also produce saw and veneer logs. Figure 10a contrasts the management costs and productivity of this regime with the previously shown Sao Paulo pulpwood management regime. Also shown is a 25-year, single thinning sawtimber regime in the SE United States. Note that in both regions the invested cost per acre is lower for the sawtimber regime: $79 vs. $995/acre for Brazil, and $734 vs. $954/acre for the SE United States.

To understand why the sawtimber regime has a lower cost-price, it is important to recall that "cost-price" is defined as the invested cost in pulpwood fiber to be harvested at clearcut. Therefore, the advantage of the sawtimber regime is that it reduces the investment cost in pulpwood by adding revenue from other products and earlier thinnings. What tends to counterbalance this reduction in cost-price is the lower total fiber productivity of the the sawtimber management regimes: 11.4 vs. 14.66 tons/ac./yr. for Sao Paulo and 4.6 vs. 4.7 tons/ac./yr. for the SE United States.

The net effect of all of these factors on stumpage cost price is illustrated in Figure 10b. If the cost of land is not considered, the stumpage cost-price is lowest with the Sao Paulo multiple-product management regime. With land costs the cost-price of the multiple-product regime is double that of the pulpwood regime. This is due to the longer rotation length and the lower yields. However, I am not certain that the numbers presented here give an adequate insight into the true potential for multiple product pine
management regimes in Brazil. For one thing, I have used sawtimber stumpage prices to assess the value of pine sawtimber (Florestar Estatistico). Because this stumpage market is relatively undeveloped, these prices likely understate the value to the sawmills. Furthermore, I think that the domestic demand for pine solidwood products is likely to increase in the future. Further silvicultural refinements to the multiple-product management regimes should also reduce the fiber productivity trade-off between the pulpwood and sawtimber regimes in Brazil.

INDUSTRIAL BENCHMARKING LESSONS

The data for making the above comparisons came from a variety of sources and involves converting Brazilian currency to U.S. dollars. All such exercises are fraught with hazards, but I think the analysis can give some insights as to the challenges and direction of industrial forestry in both countries. For my closing thoughts I will share my opinions concerning the challenges facing foresters in the Southeastern United States and Brazil. Imagine that a team of foresters from each country has just returned from a fact-finding/benchmarking trip to the other country. What follows are my guesses of what they would recommend to their respective forest industries.

Brazilian Team

Lesson #1: With increasing costs of holding land, we should more actively encourage the development of open-market sources of stumpage supply from private landowners. The ability of forest industry to expand in some regions may depend on developing these sources of supply, Figure 11.

Lesson #2: We also have the opportunity to reduce costs by developing subcontracting opportunities as long as this does not reduce labor productivity and the ability to integrate our silviculture and harvesting operations. Subcontractors can also provide a way to reduce overhead and infrastructure costs.

Lesson #3: High labor costs and the need to increase productivity is leading U.S. industry to train and empower workers in a wider variety of tasks. Even though our labor costs are relatively low, we should more aggressively train and empower workers in order to give us the flexibility to adopt more capital intensive technologies if factor price
changes make them more cost efficient.

Lesson #4: U.S. industry has effectively used solidwood products as a way of decreasing delivered fiber costs; we should work on developing that potential, particularly in the more industrialized regions.

Lesson #5: Take advantage of the perceptions that wood raw material prices in the United States will continue to increase. Seek foreign investment and expand processing capacity to more value-added products. We can learn from the United States the value of a relatively stable political climate and monetary policy. Both would help stabilize foreign exchange rates and attract long-term capital investment.

Lesson #6: We need to keep our focus on the production efficiency of dominant use management. Future industrial growth will depend on our ability to have forest plantations whose dominant use is wood production. However, we also need to develop forest management regimes for other dominant uses (recreation, wildlife, ecosystem maintenance) on acreages which might also provide some lower level of wood product supply.

Lesson #7: Continue to monitor the changes in values and perceptions of the U.S. population toward forests and forest management. Also, learn from the successes and failures of U.S. industry to respond to these changes.

Southeastern United States Team

Lesson #1: The Brazilian forest industry is relatively small with fewer resources to spend on research and development. However, they have been able to make the most of these resources by: (1) taking a global approach to borrowing and adapting technology; (2) focusing on applied forestry research aimed at increasing yields; and (3) a relatively open sharing of information between companies. We need to make changes in our research methods and priorities based on these lessons. We also need to be aware that the relatively short rotations in Brazil give them an advantage in reducing the time between the initiation and successful adoption of research. The size of our industry can help us overcome this obstacle if we devote a greater amount of time and money to cooperative research efforts.

Lesson #2: Brazilian foresters take a more agronomic approach to plantation management, looking at the growth requirements of trees in a manner similar to other agricultural crops. We need to take this more basic approach to understanding
the factors which determine the fiber production possibilities of different genotypes on different sites.

Lesson #3: Brazilian industry has sucessfully practiced dominant use management for industrial wood production. They are beginning to see the need to devote some acreage to other dominant uses such as ecosystem management, forest recreation, and wildlife. We should continue to focus on dominant use management with different acres for different uses.

Lesson #4: We should continue to monitor how forest industry in Southern Brazil is responding to state forestry regulations which in some cases are more stringent than those in the United States.

Lesson #5: Brazilian industry has focused on minimizing the cost per ton of delivered fiber. This is in contrast to the historical tendency of our industry to minimize the invested cost per acre. As we move toward a fiber supply which comes from what we grow rather than from nature’s inventory, we need to focus on minimizing cost per ton. This will most likely increase the cost invested per acre so that we need to be able to show the marginal benefit versus the marginal cost of different silvicultural techniques.
Lesson #6: Brazilian managers tend to have forest management investment planning horizons which are similar in length to ours (3 to 5 years). However, because of the shorter rotations and quicker supply response from new plantings this provides a better fit for making tactical and strategic changes. We need to lengthen our forest management investment planning horizons and devote more time to strategic planning to remain on an equal footing for supply response.

Conclusion

From our own experiences we know that not all lessons are learned to the extent that they are actually put into practice. Furthermore, these imaginary "teams" will probably return to their respective countries and find that there were constraints put in their way for making changes; even though these changes would allow them to increase production and profitability. However, Figure 1 illustrates that some information will be put into practice either by changes in values or decisions. As an economist, the fundamental lessons I would want foresters from both countries to take away are those implied by the production possibilities curve in Figure 2, namely:

- Know your production possibilities.
- Expand your production possibilities.
- Be clear about your values.
- Remove constraints.
- Know your comparative advantage.
- Seek gains from trade.

More succinctly, it might be the message I would give my teenage sons: Change the production possibilities curve where you live and/or change your values!

LITERATURE CITED


